

Research paper

Fast food consumption and suicide attempts among adolescents aged 12–15 years from 32 countries

Louis Jacob^{a,b,*}, Brendon Stubbs^{c,d,e}, Joseph Firth^{f,g,h}, Lee Smithⁱ, Josep Maria Haro^b, Ai Koyanagi^{b,j}^a Faculty of Medicine, University of Versailles Saint-Quentin-en-Yvelines, Montigny-le Bretonneux, France^b Research and Development Unit, Parc Sanitari Sant Joan de Déu, CIBERSAM, Sant Boi de Llobregat, Barcelona, Spain^c Physiotherapy Department, South London and Maudsley NHS Foundation Trust, Denmark Hill, London, United Kingdom^d Department of Psychological Medicine, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom^e Positive Ageing Research Institute, Faculty of Health, Social Care and Education, Anglia Ruskin University, Chelmsford, United Kingdom^f Division of Psychology and Mental Health, University of Manchester, Manchester, United Kingdom^g NICM Health Research Institute, Western Sydney University, Westmead, Australia^h Centre for Youth Mental Health, University of Melbourne, Melbourne, Australiaⁱ Cambridge Centre for Sport and Exercise Sciences, Anglia Ruskin University, Cambridge, United Kingdom^j ICREA, Pg. Lluís Companys 23, Barcelona, Spain

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ABSTRACT

Background: We examined the fast food consumption-suicide attempt relationship among 105,061 adolescents aged 12–15 years from 32 countries.**Methods:** This study was based on cross-sectional data from the Global School-based Student Health Survey (GSHS), and included 4 low-income, 13 lower middle-income, 9 upper middle-income, and 6 high-income countries. Data on past 7-day fast food consumption and 12-month suicide attempts were collected. The association between fast food consumption and suicide attempts was investigated with multivariable logistic regression and meta-analysis while adjusting for sex, age, food insecurity (proxy of socioeconomic status), alcohol consumption, smoking, physical activity, obesity, carbonated soft drink consumption, and fruit and vegetable consumption.**Results:** Overall, the prevalence of fast food consumption was high (53.5%) and the proportion of suicide attempts was higher among consumers of fast food compared to non-consumers (11.8% vs. 8.3%). Of the 32 countries included in the study, a positive association between fast food consumption and suicide attempts was found in 26 countries although this was not statistically significant in all countries. The pooled OR (95% CI) based on a meta-analysis was 1.31 (1.17–1.46).**Limitations:** Since this was a cross-sectional study, it is not possible to draw any conclusions about causality or temporality in the associations assessed.**Conclusions:** Fast food consumption is positively associated with suicide attempts in adolescents. Further research of longitudinal design is needed to confirm/refute our findings and explore the potential underlying mechanisms.

1. Introduction

With around 67,000 deaths, suicide was the third leading cause of

adolescent mortality in the world in 2015 (World Health Organization, 2017). Suicide attempt is one of the strongest predictors of completed suicide, and it has been previously found in a US case-

Abbreviations: BMI, body mass index; CDC, Centers for Disease Control and Prevention; CI, confidence interval; CRP, C-reactive protein; GDP, gross domestic product; GSHS, Global School-based Student Health Survey; HIC, high-income country; LMIC, low- and middle-income country; OR, odds ratio; PACE+, Patient-Centered Assessment and counseling for Exercise Plus Nutrition; RCT, Randomized Controlled Trial; UN, United Nations; US, United States; WHO, World Health Organization; YRBS, Youth Risk Behavior Survey

* Corresponding author at: Faculty of Medicine, University of Versailles Saint-Quentin-en-Yvelines, 2 avenue de la Source de la Bièvre, Montigny-le Bretonneux 78180, France.

E-mail address: louis.jacob.contacts@gmail.com (L. Jacob).

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Table 1
Survey characteristics and age- and sex- adjusted prevalence of fast food consumption.

Country income	Country	Year	Response rate (%) [†]	N [‡]	Fast food (%) [95%CI]
Low	Benin	2009	90	1170	52.1 [49.3,54.9]
	Cambodia	2013	85	1812	26.7 [22.7,31.1]
	Mozambique	2015	80	668	66.2 [54.7,76.0]
	Tanzania	2014	87	2615	35.0 [29.9,40.4]
	Total			6265	37.7 [33.8,41.8]
Lower middle	Bangladesh	2014	91	2753	53.6 [49.7,57.5]
	Bolivia	2012	88	2804	57.0 [54.3,59.6]
	East Timor	2015	79	1631	67.8 [63.8,71.4]
	Ghana	2012	82	1110	70.0 [60.7,77.9]
	Honduras	2012	79	1486	47.5 [43.5,51.6]
	Indonesia	2015	94	8806	54.3 [51.9,56.8]
	Kiribati	2011	85	1340	45.1 [41.1,49.1]
	Laos	2015	70	1644	40.0 [34.6,45.6]
	Mongolia	2013	88	3707	55.0 [49.5,60.4]
	Philippines	2015	79	6162	52.4 [46.5,58.2]
	Samoa	2011	79	2200	78.4 [74.6,81.8]
	Solomon Islands	2011	85	925	63.8 [52.6,73.8]
	Vanuatu	2011	72	852	56.5 [46.6,66.0]
	Total			35,420	54.2 [52.2,56.2]
	Antigua and Barbuda	2009	67	1235	55.3 [52.0,58.5]
	Argentina	2012	71	21,528	32.1 [29.8,34.5]
	Costa Rica	2009	72	2265	53.4 [48.3,58.5]
Upper middle	Malaysia	2012	89	16,273	48.6 [46.8,50.3]
	Namibia	2013	89	1936	54.8 [48.3,61.1]
	Peru	2010	85	2359	49.9 [45.9,53.9]
	Suriname	2009	89	1046	63.4 [58.9,67.6]
	Thailand	2015	89	4132	79.8 [77.8,81.7]
	Tuvalu	2013	90	679	42.3 [38.4,46.4]
	Total			51,453	58.6 [57.4,59.7]
	Bahamas	2013	78	1308	72.8 [68.0,77.2]
	Brunei Darussalam	2014	65	1824	66.0 [63.7,68.1]
	Curaçao	2015	83	1498	69.8 [67.1,72.4]
High	Seychelles	2015	82	2061	70.1 [66.8,73.2]
	Trinidad & Tobago	2011	90	2363	65.5 [62.1,68.8]
	Uruguay	2012	77	2869	48.5 [45.6,51.5]
	Total			11,923	56.5 [54.6,58.4]

Abbreviation: CI, Confidence interval.

[†] Response rate was calculated as school response rate multiplied by student response rate.

[‡] Based on sample aged 12–15 years.

control study that boys who attempted suicide were at a 30-fold increased risk for completed suicide compared to controls (Shaffer et al., 1996). Furthermore, young people who attempt suicide are more likely to have mental (e.g., depression, substance dependence) and physical health problems (e.g., metabolic syndrome) in adulthood than non-attempters, while they engage more often in violent behaviors and need more social support (Goldman-Mellor et al., 2014). Therefore, identifying risk factors for suicide attempts in adolescents is a public health priority.

In the past years, there has been an increasing interest in the role of diet quality on the mental health of adolescents (Jacka et al., 2013, 2011, 2010; Khalid et al., 2016; Kulkarni et al., 2015; Oddy et al., 2009; O'Neil et al., 2014; Park et al., 2018, 2016; Rao et al., 2015; Robinson et al., 2011; Sinclair et al., 2016; Trapp et al., 2016; Weng et al., 2012; Zahedi et al., 2014). For example, studies from Australia showed that a Western dietary pattern (e.g., take-away foods, fried potatoes, full fat dairy products) or an unhealthy diet is associated with poorer mental health outcomes (e.g., aggressiveness) (Oddy et al., 2009) and increased risk for mental disorders (e.g., depression) (Jacka et al., 2011). It has been suggested that an unhealthy diet may lead to psychiatric conditions via systemic inflammation, oxidative stress, and decreased brain plasticity (Heidari et al., 2019).

In terms of suicidal behavior, to the best of our knowledge, only one previous study has investigated its association with fast food consumption. Specifically, this South Korean study including 68,043 adolescents aged 12–18 years showed that frequent junk food and energy drink consumption was associated with a significantly increased odds

for suicidal ideation, suicide plan, and suicide attempt compared to infrequent junk food and energy drink consumption (Park et al., 2016). However, this study failed to investigate the association between fast food consumption and suicidal behavior independently of energy drink consumption. Indeed, our recent work has shown carbonated soft drink consumption to be associated with suicidal behavior, independently of fast food consumption itself (Jacob et al., 2019). Thus, the exact association between fast food consumption and suicide attempts remains to be elucidated.

Given the fact that fast food consumption is frequent in adolescents worldwide (Mohammadbeigi et al., 2018), and is increasing particularly rapidly in low- and middle-income countries (LMICs), investigating the association between fast food consumption and suicide attempts from a global perspective is of particular importance to understand the potential impact of fast food consumption on mental well-being among adolescents. Therefore, the aim of this study was to analyze the association between fast food consumption and suicide attempts among adolescents aged 12–15 years from 32 predominantly LMICs.

2. Methods

2.1. The survey

Publicly available data from the Global School-based Student Health Survey (GSHS) were analyzed. Details on this survey can be found at <http://www.who.int/chp/gshs> and <http://www.cdc.gov/gshs>. Briefly,

the GSHS was jointly developed by the World Health Organization (WHO) and the US Centers for Disease Control and Prevention (CDC), and other United Nations (UN) allies. The core aim of this survey was to assess and quantify risk and protective factors of major non-communicable diseases. The survey draws content from the CDC Youth Risk Behavior Survey (YRBS) for which test-retest reliability has been established (Brener et al., 1995). The survey used a standardized two-stage probability sampling design for the selection process within each participating country. For the first stage, schools were selected with probability proportional to size sampling. The second stage involved the random selection of classrooms which included students aged 13–15 years within each selected school. All students in the selected classrooms were eligible to participate in the survey regardless of age. Data collection was performed during one regular class period. The questionnaire was translated into the local language in each country and consisted of multiple-choice response options; students recorded their response on computer scannable sheets. All GSHS surveys were approved, in each country, by both a national government administration (most often the Ministry of Health or Education) and an institutional review board or ethics committee. Student privacy was protected through anonymous and voluntary participation, and informed consent was obtained as appropriate from the students, parents and/or school officials. Data were weighted for non-response and probability selection.

From all publicly available data, we selected all nationally representative datasets that included the variables pertaining to this analysis. If there were more than two datasets from the same country, we chose the most recent dataset. Thus, a total of 32 countries were included in the current study (Supplementary Figure 1). The characteristics of each country or survey (including response rates) are provided in Table 1. For the included countries, the survey was conducted between 2009 and 2015, and consisted of 4 low-income ($n = 6265$), 13 lower middle-income ($n = 35,420$), 9 upper middle-income ($n = 51,453$), and 6 high-income countries ($n = 11,923$) based on the World Bank classification at the time of the survey for the respective countries.

2.2. Suicide attempts (dependent variable)

Suicide attempt was assessed by the question “During the past 12 months, how many times did you actually attempt suicide?” and was defined as at least one suicide attempt in the past 12 months (Jacob et al., 2019).

2.3. Fast food consumption (independent variable)

Fast food consumption was assessed with the question “During the past 7 days, on how many days did you eat food from a fast food restaurant?” with country specific examples on fast food restaurants. Those who consumed fast food on at least one day in the past 7 days were considered to be consumers of fast food (Ashdown-Franks et al., 2019a; Pengpid and Peltzer, 2019; Rao et al., 2015).

2.4. Control variables

The selection of the control variables was based on past literature (Jacka et al., 2013, 2011, 2010; Jacob et al., 2019; Khalid et al., 2016; Kulkarni et al., 2015; Oddy et al., 2009; O’Neil et al., 2014; Park et al., 2018, 2016; Rao et al., 2015; Robinson et al., 2011; Sinclair et al., 2016; Trapp et al., 2016; Weng et al., 2012; Zahedi et al., 2014), and included sex, age, food insecurity (proxy of socioeconomic status), alcohol consumption, smoking, physical activity, obesity, carbonated soft drink consumption, and fruit and vegetable consumption. As in a previous GSHS study, food insecurity was used as a proxy for socioeconomic status as there were no variables on socioeconomic status in the GSHS (Ashdown-Franks et al., 2019b). Specifically, this was assessed by the

question “During the past 30 days, how often did you go hungry because there was not enough food in your home?” Answer options were categorized as “never”, “rarely/sometimes”, and “most of the time/always”. Alcohol consumption was defined as having had at least one drink containing alcohol in the past 30 days. Smoking referred to the use of any form of tobacco on at least one day in the past 30 days. To assess levels of physical activity, questions that represented the Patient-Centered Assessment and Counseling for Exercise Plus Nutrition (PACE+) Adolescent Physical Activity Measure were asked (Prochaska et al., 2001). This measure has been tested for validity and reliability (Prochaska et al., 2001). The questions asked about the number of days with physical activity of at least 60 min during the past 7 days. Trained survey staff conducted measurement of weight and height. Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared. Obesity was defined as >2 SDs above the median for age and sex based on the 2007 WHO Child Growth reference (Caleyachetty et al., 2015). Consumption of carbonated soft drinks was assessed with the question “During the past 30 days, how many times per day did you usually drink carbonated soft drinks?” The student was instructed not to include diet soft drinks. This variable was dichotomized as ≥ 1 time or not. Low fruit and vegetable consumption was defined as intake of fruit and vegetables less than five times per day (<400 g of fruits and vegetables/day) during the past 30 days (Caleyachetty et al., 2015).

2.5. Statistical analysis

Statistical analyses were performed with Stata 14.1 (Stata Corp LP, College station, Texas). The analysis was restricted to those aged 12–15 years as the exact age outside of this age range was not available in the majority of the countries, while most students were within this age range. Age- and sex-adjusted prevalence of fast food consumption by country and country income level was calculated using the proportions derived from the overall sample as the standard population. The difference in sample characteristics by fast food consumption was tested by Chi-squared tests and Student’s *t*-tests for categorical and continuous variables, respectively. We used multivariable logistic regression analysis to estimate the association between fast food consumption (independent variable) and suicide attempts (dependent variable) using country-wise samples while adjusting for sex, age, food insecurity (proxy of socioeconomic status), alcohol consumption, smoking, physical activity, obesity, carbonated soft drink consumption, and fruit and vegetable consumption. In order to assess between-country heterogeneity in the association between fast food consumption and suicide attempts, we calculated the Higgins’s I^2 which represents the degree of heterogeneity that is not explained by sampling error with a value of $<40\%$ often considered as negligible and 40% – 60% as moderate heterogeneity (Higgins and Thompson, 2002). A pooled estimate was obtained by combining the estimates for each country into a random effect meta-analysis (overall and by country-income level). Finally, we also conducted a sensitivity analysis with a different cut-off for fast food consumption to assess whether results may differ. Specifically, following the lead of a previous publication (Park et al., 2016), the variable on fast food consumption was dichotomized into frequent (i.e., ≥ 3 days in the past 7 days) and infrequent (i.e., ≤ 2 days in the past 7 days) consumption. All variables were included in the regression analysis as categorical variables with the exception of age and physical activity, which were continuous variables. Under 3.9% of the data were missing for the variables included in the study with the exception of BMI (18.4%). We included a missing category only for BMI so as not to exclude a large number of individuals from the analysis. Sampling weights and the clustered sampling design of the surveys were taken into account to obtain nationally representative estimates. Results from the logistic regression analyses are presented as odds ratios (ORs) with 95% confidence intervals (CIs). The level of statistical significance was set at $p < 0.05$.

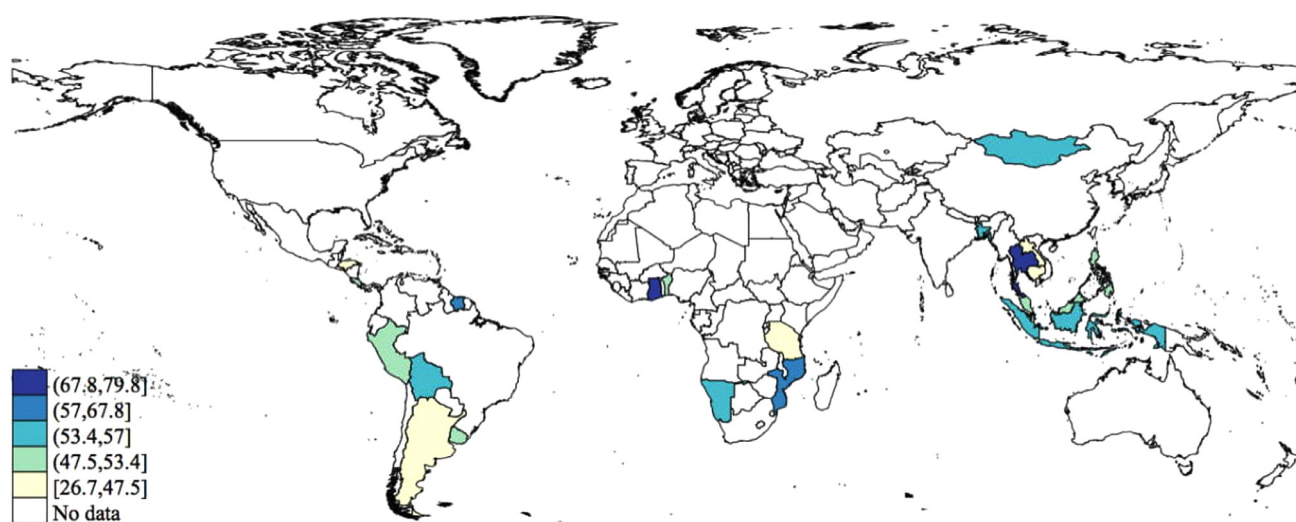


Fig. 1. Age- and sex-adjusted prevalence of fast food consumption by country.

3. Results

The final sample comprised 105,061 adolescents aged 12–15 years [mean (SD) age 13.7 (1.0) years; 49.0% females]. The overall prevalence of suicide attempts and fast food consumption were 10.2% (95%CI = 9.4%–11.1%) and 53.5% (95%CI = 51.7%–54.8%), respectively. The age- and sex-adjusted prevalence of fast food consumption varied widely between countries [range 26.7% (Cambodia)–79.8% (Thailand)] with the lowest prevalence of fast food consumption being observed in low-income countries (Table 1, Fig. 1). The prevalence of young age, hunger, alcohol consumption, smoking, obesity, carbonated soft drink consumption, and adequate fruit/vegetable consumption was significantly higher in consumers of fast food, while levels of physical activity were also slightly higher in this group (Table 2).

Overall, the prevalence of suicide attempts was higher among consumers of fast food compared to non-consumers (11.8% vs. 8.3%) (Fig. 2). The figures were similar for boys and girls. The country-wise association between fast food consumption and suicide attempts estimated by multivariable logistic regression is shown in Fig. 3. Of the 32 countries included in the study, a positive association ($OR > 1$) between fast food consumption and suicide attempts was found in 26 countries although this was not statistically significant in all countries. Overall, the pooled OR (95%CI) based on a meta-analysis was 1.31 (1.17–1.46) with a high level of between-country heterogeneity ($I^2 = 70.8\%$). The pooled estimate by country-income level showed that the association is most pronounced in low-income countries ($OR = 1.68$; 95%CI = 1.40–2.03), followed by lower middle-income countries ($OR = 1.34$; 95%CI = 1.15–1.57), and upper middle-income countries ($OR = 1.30$; 95%CI = 1.01–1.68). The association was not significant in high-income countries ($OR = 1.05$; 95%CI = 0.90–1.23). The overall estimate based on the sensitivity analysis (i.e., frequent vs. infrequent fast food consumption) was similar ($OR = 1.35$; 95%CI = 1.24–1.46). However, the level of between-country heterogeneity was lower ($I^2 = 17.1\%$) and a significant fast food consumption-suicide attempt relationship in high-income countries ($OR = 1.39$; 95%CI = 1.17–1.65) was also observed (Supplementary Fig. 2).

4. Discussion

4.1. Main findings

This nationally representative study including data on adolescents from 32 countries, which were predominantly LMICs, showed that the

Table 2

Sample characteristics (overall and by fast food consumption).

Characteristic	Category	Overall	Fast food consumption		P value*
			No	Yes	
Sex	Male	51.0	51.1	50.8	0.705
	Female	49.0	48.9	49.2	
Age (years)	12	12.4	11.5	13.2	0.006
	13	28.0	28.0	28.0	
	14	32.9	32.4	33.2	
	15	26.8	28.1	25.6	
Hunger	Never	45.6	47.3	43.9	<0.001
	Rarely/sometimes	47.7	46.9	48.6	
	Most of the time/always	6.7	5.8	7.5	
	No	89.7	91.3	88.3	
Alcohol consumption	Yes	10.3	8.7	11.7	<0.001
	No	88.3	90.4	86.5	
Smoking	Yes	11.7	9.6	13.5	<0.001
	No	88.3	90.4	86.5	
Physical activity	Mean (SD)	2.4 (2.5)	2.3 (2.6)	2.4 (2.4)	0.026
	Obesity	95.7	96.0	95.4	
Carbonated soft drink consumption	Yes	4.3	4.0	4.6	<0.001
	No	58.0	67.4	49.8	
Fruit and vegetable consumption	High	24.5	19.8	28.6	<0.001
	Low	75.5	80.2	71.4	

Abbreviation: SD, Standard deviation.

Data are% unless otherwise stated.

* P value is based on Chi-squared tests for all variables with the exception of physical activity (Student's *t*-test).

prevalence of fast food consumption in the past 7 days was high worldwide (overall 53.5%), while the proportion of suicide attempts in the past 12 months was higher in consumers of fast food than in non-consumers (11.8% vs. 8.3%). Overall, after adjusting for several potential confounders (i.e., sex, age, food insecurity, alcohol consumption, smoking, physical activity, obesity, carbonated soft drink consumption, fruit and vegetable consumption), fast food consumption was associated with a significant 1.31-fold increase in the odds for suicide attempts in adolescents. Finally, the fast food consumption-suicide attempt relationship tended to be strongest in low-income countries. To the best of our knowledge, this is the first study that provided specific estimates on the association between fast food consumption and suicide attempts.

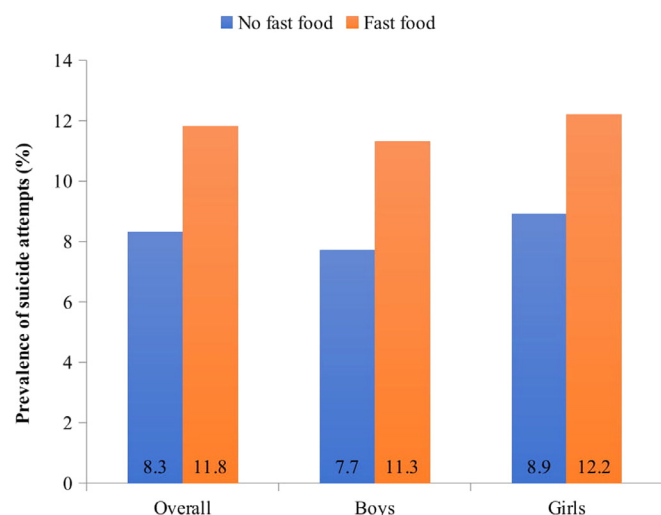


Fig. 2. Prevalence of suicide attempts by fast food consumption. Bars denote 95% confidence interval.

4.2. Interpretation of the findings

Although the mechanisms underlying the association between fast food consumption and suicide attempts can only be speculated, several hypotheses may be proposed. First, increased levels of inflammation as a result of fast food consumption may increase risk for suicidal behavior. For example, adherence to Western dietary patterns (e.g., snacks, pizza, sweets and desserts) has been linked with high serum levels of C-reactive protein (CRP) among adolescents (Khayyatadeh et al., 2018), while a positive association between systemic inflammation and suicide risk has been reported (Batty et al., 2018). Second, children and adolescents consuming fast food are more likely to be diagnosed with metabolic syndrome than those not consuming fast food (Asghari et al., 2015), and metabolic syndrome may lead in turn to suicide via insulin resistance (Chang et al., 2013). Finally, fast food consumption may increase risk for suicide attempts by increasing vulnerability to traumatic stress via alterations in brain structure and function. Specifically, it has been shown in rats that the consumption of a Western high-fat diet increases susceptibility to traumatic stress via hippocampal atrophy and lateral ventricular enlargement (Kalyan-Masih et al., 2016), while stress is a well-known predictor of suicide attempts in adolescents and young adults (Lee et al., 2019).

An interesting finding of the present study is that the association between fast food consumption and suicide attempts tended to be stronger in low- and middle-income countries (LMICs) than in high-income countries (HICs). There are several hypotheses to explain this differential association. Substantial differences may exist between LMICs and HICs in terms of fast food quality. Street food restaurants are highly common in LMICs (Steyn et al., 2014), while international chains of restaurants (e.g., McDonald's, KFC, Subway) are well implanted in HICs (Fraser et al., 2010). Thus, food composition may vary between these settings, and LMICs may be at a greater risk for unhealthy fast food than HICs. For example, in response to the rising public awareness regarding nutrition over the last decades, chains of fast food restaurants have made efforts to improve the quality of their products. A US study using data from eight fast-food restaurant chains found an improvement in the nutritional quality of menu offerings among six of these restaurants between 1997/1998 and 2009/2010 (Hearst et al., 2013). Another study including 66 large chain restaurants further described a decrease by 14% in the amount of calories in newly introduced menu items between 2012 and 2014 (Bleich et al., 2016). In contrast, a review of 23 studies reported that street food is under-regulated in LMICs, while this type of food contains high levels of

saturated fat, sugar and salt (Steyn et al., 2014). Next, it is possible that there are differences in the household characteristics among adolescents who do and do not consume fast food between LMICs and HICs. Since fast food consumption has been very common in HICs for many years, this eating pattern may not be related to a particular characteristic of the household. However, given that fast food consumption is less frequent in LMICs, it may be the case that this is more likely to reflect certain characteristics of the household that were unmeasured in this study and linked to worse mental health such as parental factors (e.g., neglect). This is an area for future research. Finally, it is also possible that the stronger association observed in LMICs may be related with limited availability of mental health care in this setting compared to HICs. LMICs often lack basic mental health policies and infrastructures, while budgets allocated to mental health are very low in these countries [i.e., <1% of the gross domestic product (GDP)] (Rathod et al., 2017).

4.3. Policy implications and directions for future research

Fast food consumption in adolescence has been associated with a myriad of adverse physical health outcomes [e.g., higher BMI (Braithwaite et al., 2014), metabolic syndrome (Asghari et al., 2015)], and our study provides further justification for advising against this habit in adolescence as it may also lead to poorer mental health outcomes. Regarding LMICs, there is an urgent need for better regulation and control of the fast food market. This may require regulating the number of street food vendors, analyzing food quality, and controlling food preparation and sale (Rane, 2011). In addition, future research should focus on the mechanisms linking consumption of fast food with suicide attempts. This may involve investigating the biological effects of fast food consumption on health (e.g., systemic inflammation, brain function, oxidative stress), but also the context of fast food consumption (e.g., parental factors). Finally, as recent meta-analyses of randomized controlled trials (RCTs) have shown that dietary improvement can reduce symptoms of depression across the general population (Firth et al., 2019), further trials should be conducted to see if interventions which decrease fast food consumption and improve dietary nutrition are also effective for reducing suicidal behavior.

4.4. Strengths and limitations

The use of nationally representative data from 32 countries spanning multiple continents and the large sample size are the two major strengths of this study. Nonetheless, this study has several limitations that should be acknowledged. First, there were no data on the type of fast food consumed, and such data may have led to a better understanding of the association between fast food consumption and suicide attempts. Second, apart from BMI, all variables were self-reported, and thus, there remains the possibility of recall and reporting bias. Third, there was a difference in the timeframe between fast food consumption (past 7 days) and suicide attempts (past 12 months). That being said, it is unlikely that fast food habits largely change within a timeframe of 12 months. Fourth, this study included adolescents attending school, and thus our findings may not be generalizable to those not attending school. Finally, since this was a cross-sectional study, it is not possible to draw any conclusions about causality or temporality in the associations assessed.

4.5. Conclusions

Fast food consumption was positively associated with suicide attempts in adolescents especially in LMICs. Further research with longitudinal design is needed to better understand causality. If a causal association between fast food consumption and suicidal behavior exists, this information may serve as a further justification to strengthen efforts to reduce fast food consumption among adolescents (i.e., not only to improve physical health but also mental health). This may be

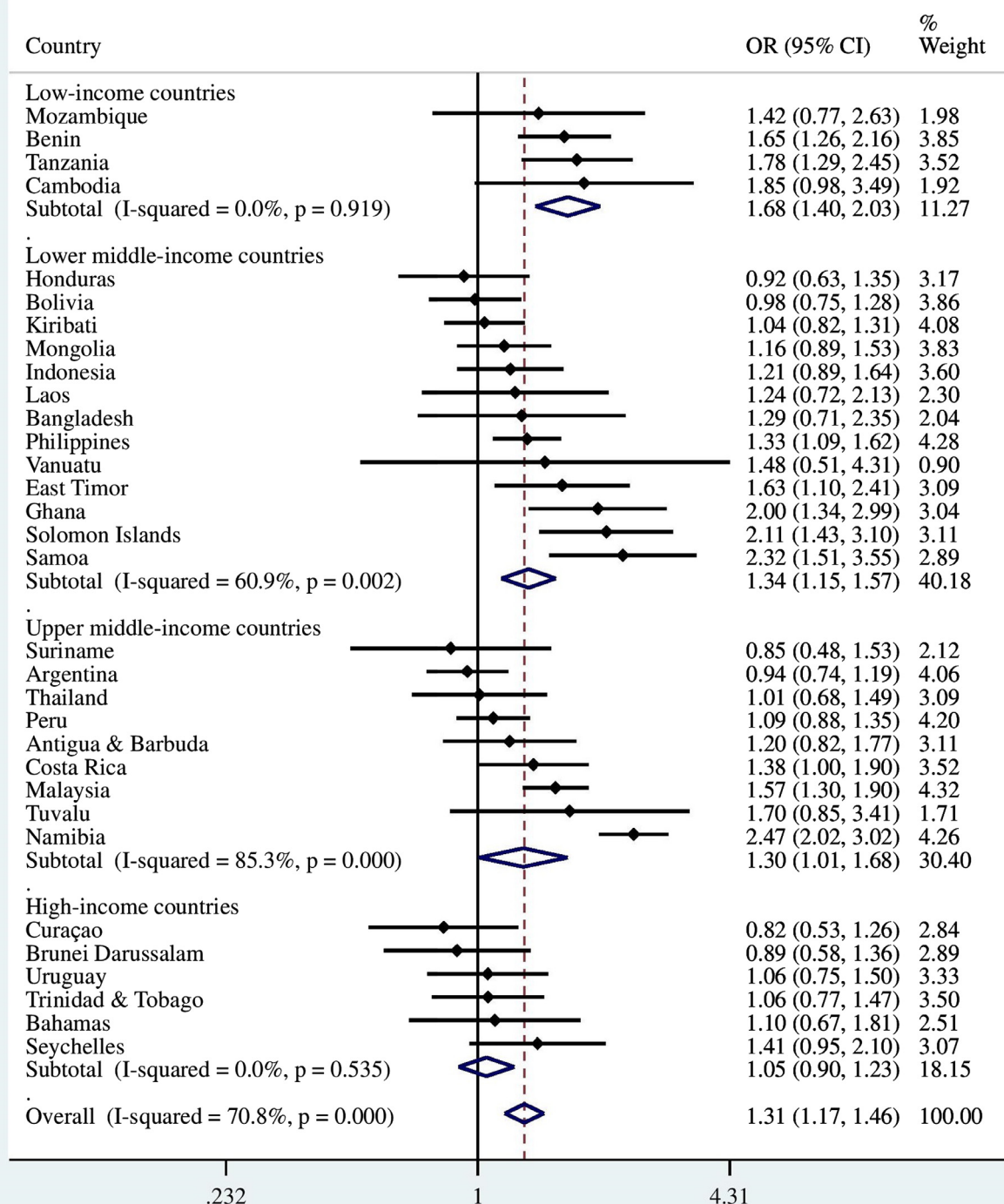


Fig. 3. Country-wise association between fast food consumption and suicide attempts estimated by multivariable logistic regression. Abbreviation: OR Odds ratio; CI Confidence intervals. Models are adjusted for sex, age, food insecurity (proxy of socioeconomic status), alcohol consumption, smoking, physical activity, obesity, carbonated soft drink consumption, and fruit and vegetable consumption. Overall estimate was obtained by meta-analysis with random effects.

particularly important in LMICs where the quality of fast food may be poor, and where consumption of fast food is increasing at a rapid pace due to changing lifestyles.

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Data availability

The datasets supporting the conclusions of this article are available at www.cdc.gov.

CRediT authorship contribution statement

Louis Jacob: Conceptualization, Writing - original draft, Writing - review & editing. **Brendon Stubbs:** Conceptualization, Writing - review & editing. **Joseph Firth:** Conceptualization, Writing - review & editing. **Lee Smith:** Conceptualization, Writing - review & editing. **Josep Maria Haro:** Conceptualization, Writing - review & editing. **Ai Koyanagi:** Conceptualization, Formal analysis, Writing - review & editing.

Declaration of Competing Interest

All authors declare that they have no conflicts of interest.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [doi:10.1016/j.jad.2020.01.130](https://doi.org/10.1016/j.jad.2020.01.130).

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