

Food insecurity with hunger and sexual behavior among adolescents from 53 countries

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ABSTRACT

Objectives: To examine the relationship of food insecurity with sexual intercourse, multiple sexual partners and non-condom use.

Methods: Data on food insecurity (hunger) and sexual behaviors from 205,296 adolescents from 53 countries were analyzed. Associations were analyzed using meta-analysis.

Results: Overall, 16.0% of the students ever had sexual intercourse and the overall prevalence of moderate and severe food insecurity was 44.9% and 6.2%, respectively. Moderate and severe food insecurity was associated with higher odds for sexual intercourse. Any food insecurity was significantly associated with condom non-use at last sex.

Conclusions: Food insecurity was associated with higher odds of ever having sexual intercourse dose-dependently.

Key Words: Adolescent Health/Medicine; Psychosocial Issues; Developmental/Behavioral Issues

INTRODUCTION

Sexual intercourse in adolescents has been shown to be associated with many deleterious consequences. For example, it has been shown that adults who reported first having had sexual intercourse during young adolescence were more likely than those who first had intercourse in late adolescence to have numerous mental health problems (Mota, Cox, Katz, & Sareen, 2010). A recent study found that engaging in sexual intercourse in adolescence was associated with increased risk of suicide attempt and that having had multiple sexual partners may increase the risk of suicide attempts (Smith et al., 2020). Moreover, sexual intercourse in adolescence is associated with a high prevalence of sexually transmitted infections when compared to other populations. For instance, it has been shown that teenage females report the highest rates of Chlamydia infection (Centers for Disease Control and Prevention, 2018b). Finally, adolescent sexual intercourse can result in pregnancy. This can lead to interruptions in education, subsequently producing a history of poor education that can have lasting negative impacts on future life trajectories (Klein, 2005). Adolescent pregnancy also carries high risks of eclampsia, puerperal endometritis, and systemic infections (World Health Organization, 2018), while complications during pregnancy and childbirth are the leading cause of death for 15 to 19-year-old girls especially in low- and middle-income countries (LMICs) (World Health Organization, 2018). In addition, every year, approximately 3.9 million girls aged 15 to 19 years undergo unsafe abortions. These findings from previous research suggest that risky sexual intercourse in adolescents should be discouraged on a global scale. In order to achieve this goal, correlates of sexual activity and risky sexual behavior among the adolescent population should be identified to inform targeted interventions.

One understudied potential correlate is food insecurity. Food insecurity is defined as “limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire food in socially acceptable ways” (United States Department of Agriculture Food and Nutrition Service, 2000). Food insecurity is prevalent and on the rise globally (FAO, IFAD, UNICEF, WFP and WHO, 2019). For example, undernourishment (one aspect of food insecurity) occurs in 10.8% of the global population, with rates varying from 5.5% in South America to 30.8% in Eastern Africa. Moreover, the phenomenon of food insecurity is not unique to LMICs; it is also prevalent in high-income countries (HICs) (FAO, IFAD, UNICEF, WFP and WHO, 2019). It is possible that female adolescents, especially from LMICs, engage in sexual activity with male partners due to their reliance on the male partner for food provision (Masa, Graham, Khan, Chowa, & Patel, 2019). Moreover, food insecurity may lead to risky sexual behavior as food insecurity likely has a negative influence on the ability of young people to consider the long-term consequences of risky behaviors (Masa, et al., 2019). If adolescents do not have adequate access to food, they may become less concerned about the future and more worried about satisfying their immediate basic needs (Masa, et al., 2019).

However, to date, there are only a few studies on this topic, and most have focused on adults, women, or people living with human immunodeficiency virus (HIV), with most studies being conducted in Africa. For example, in a systematic review focusing on women living with HIV, it was found that food insecurity was associated with increased sexual risk through transactional sex and inability to negotiate safer sex (Chop et al., 2017). Moreover, another study found that food insufficiency was an important risk factor for increased sexual risk-taking (i.e., inconsistent condom use with a non-primary partner, sex exchange, intergenerational sexual relationships, and lack of control in sexual relationships) among

women in Botswana and Swaziland (Weiser et al., 2007). In terms of studies on adolescents, we are aware of only one study from Ghana. This small study (n=773) found that food insecurity was significantly associated with unwanted sexual contact among adolescents (Masa et al., 2019).

To date, multinational studies exploring associations between food insecurity, sexual intercourse, multiple sexual partners and non-condom use in adolescents have not been undertaken. Multinational studies are important as they can shed light on whether associations are generalizable across countries, while between-country differences may provide hints on how factors such as culture may influence associations. Associations may differ between countries owing to differing levels of food insecurity. For example, in 2017, Sub-Saharan Africa had the highest prevalence of food insecurity (55%) and severe food insecurity (28%), followed by Latin America and the Caribbean (32% food insecure and 12% severely food insecure), and South Asia (30% food insecure and 13% severely food insecure). Furthermore, the prevalence of food insecurity and severe food insecurity were lowest in North America, Eastern Europe, and Central Asia (United States Department of Agriculture, 2019). Finally, no study has investigated the relationship between food insecurity and multiple sexual partners although such an association is likely to exist.

Given the above-mentioned gap in the literature, the present study examined the relationship of food insecurity with sexual intercourse, multiple sexual partners and non-condom use among 205,296 adolescents living in 53 countries from four WHO regions [AFR (African Region), AMR (Region of the Americas), SEAR (South-East Asia Region), and WPR (Western Pacific Region)]. We will test the hypothesis that higher levels of food insecurity will be associated with increased odds for sexual intercourse, multiple sexual partners and

non-condom use, globally. Examining the association between food insecurity and sexual behavior of adolescents is important to identify whether food insecurity is a potentially modifiable risk factor for sexual intercourse and risky sexual behavior, as well as the consequent potentially detrimental impacts on health and wellbeing.

METHODS

Methods

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> (Centers for Disease Control and Prevention, 2018a; World Health Organization, 2012). Briefly, the GSHS was jointly developed by the WHO, the US Centers for Disease Control and Prevention (CDC), and other UN agencies. The core aim of this survey was to assess and quantify risk and protective factors of major non-communicable diseases among young people. The survey draws content from the CDC Youth Risk Behavior Survey (YRBS) for which adequate test-retest reliability has been established (Brener, Collins, Kann, Warren, & Williams, 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, and thus, the survey also included students who were not within this age range (i.e., 13-15 years). Data collection was performed during one regular classroom teaching session. The questionnaire was translated into the local language in each country and comprised multiple choice response options; students recorded their responses 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 used in the current analysis. If there were more than two datasets from the same country, we chose the most recent dataset. A total of 53 countries were included in the current study. The characteristics of each country or survey are provided in **Table 1**. For the included countries, the survey was conducted between 2003 and 2016, and in 14, 22, 5, and 12 countries from AFR, AMR, SEAR, and WPR, respectively.

Sexual behavior

Lifetime sexual intercourse was assessed by the question “Have you ever had sexual intercourse?” with ‘yes’ and ‘no’ answer options. Condom use was assessed with the question “The last time you had sexual intercourse, did you or your partner use a condom?” with ‘yes’ and ‘no’ answer options. Number of sexual partners was based on the question “During your life, with how many people have you had sexual intercourse?” We considered those with two or more sexual partners to have multiple sexual partners. Data on multiple partners were not available from Bangladesh and Kenya.

Food insecurity with hunger

Food insecurity (hunger) 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 no food insecurity (never), moderate food insecurity (rarely/sometimes), and severe food insecurity (most of the time/always) (McKinnon, Gariépy, Sentenac, & Elgar, 2016). We named these categories as such since moderate food insecurity is often considered to be an indication that quality/quantity of food consumed has been compromised, while severe food insecurity refers to reduced food intake and disrupted eating patterns (McIntyre, Williams, Lavorato, & Patten, 2013). For some analyses, a dichotomized variable on any food insecurity was used (i.e., answering rarely, sometimes, most of the time, or always).

Control variables

The control variables were based on previous studies (Weiser et al., 2007), and we selected those that have been reported to be independently associated with both the independent and dependent variables. Control variables included sex, age, and alcohol consumption. Alcohol consumption was assessed with the question “During the past 30 days, on how many days did you have at least one drink containing alcohol?” Those who answered one or more days were considered to be consumers of alcohol.

Statistical analysis

Statistical analyses were performed with Stata 14.1 (Stata Corp LP, College station, Texas). The association between food insecurity (exposure) and sexual intercourse, condom non-use, or multiple sex partners (outcomes) was assessed by country-wise multivariable logistic regression analyses. The analysis on condom non-use and multiple sex partners was restricted to those who ever had sexual intercourse ($n=44,677$). The three-category variable on food insecurity (i.e., never, rarely/sometimes, most of the time/always) was used for the analysis on sexual intercourse but for the analysis restricted to those who ever had sex (i.e., condom

non-use and multiple sex partners), we used the dichotomized variable (i.e., any food insecurity) as the sample size was small in each country and stable estimates could not be obtained. Analyses were also stratified by sex.

Pooled estimates for all countries and region-wise samples were obtained by meta-analysis with random effects based on country-wise estimates. In order to assess the level of between-country heterogeneity in the association between food insecurity and sexual behavior, we also calculated the Higgins's I^2 which represents the degree of heterogeneity that is not explained by sampling error with values of <40% considered as negligible and 40-60% as moderate heterogeneity (Higgins, & Thompson, 2002).

All regression analyses were adjusted for sex, age, and alcohol consumption with the exception of the sex-stratified analysis, which was not adjusted for sex. All variables were included in the regression analysis as categorical variables with the exception of age (continuous variable). Sampling weights and the clustered sampling design of the surveys were taken into account. 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 $p < 0.05$.

RESULTS

A total of 205,296 adolescents attending school were included in the analysis (50% girls). The proportion of students for each age was: 1.6% (≤ 11 years); 7.8% (12 years); 17.8% (13 years); 24.3% (14 years); 20.5% (15 years); and 28.0% (≥ 16 years). Overall, 16.0% (boys 20.1%; girls 11.5%) of the students ever had sexual intercourse and among these individuals, 42.6% (boys 42.2%; girls 43.3%) did not use a condom at last sexual intercourse, while

54.3% (boys 59.7%; girls 43.7%) had had multiple sex partners. The overall prevalence of moderate and severe food insecurity was 44.9% and 6.2%, respectively. The prevalence of sexual behaviors and food insecurity varied widely across countries, with the prevalence of both sexual intercourse and food insecurity being particularly high in African countries (**Table 2**). The association of moderate or severe food insecurity (vs. no food insecurity) with sexual intercourse estimated by multivariable logistic regression and meta-analysis is shown in **Table 3**. In the overall sample, after adjustment for age, sex, and alcohol use, compared to no food insecurity, moderate and severe food insecurity was associated with 1.14 (95%CI=1.08-1.20) and 1.51 (95% CI=1.36-1.67) times higher odds for sexual intercourse, respectively. Significant associations were observed for all regions and for both sexes for severe food insecurity, with a particularly strong association being observed for girls in SEAR (OR=2.41; 95%CI=1.51-3.86). For moderate food insecurity, significant associations were observed for all regions for the overall sample, but some estimates were not statistically significant for the sex-stratified analyses. **Table 4** shows the association between any food insecurity and condom non-use or multiple sex partners among those who ever had sex estimated by meta-analysis based on country-wise multivariable logistic regression. Any food insecurity was significantly associated with condom non-use at last sex in the overall sample (OR=1.19; 95%CI=1.09-1.30), and those from AMR (OR=1.31; 95%CI=1.19-1.45) and WPR (OR=1.31; 95%CI=1.08-1.59). In these samples, the association was significant only among boys. Food insecurity was only significantly associated with having multiple sex partners in SEAR among boys (OR=1.48; 95%CI=1.01-2.16). The country-wise analyses on which the results in Table 3 and Table 4 were based on can be found in the Supplementary material (Tables S1-S12). For most analyses, the level of between-country heterogeneity as assessed by the Higgin's I^2 was low.

DISCUSSION

In this large global sample of 205, 296 adolescents from 53 countries, approximately 51% of the sample reported some level of food insecurity. Moreover, food insecurity was associated with higher odds of ever having sexual intercourse dose-dependently. Among those who ever had sex, any food insecurity was associated with non-condom use at last sexual encounter in the overall sample, while having multiple sexual partners was significantly associated with any food insecurity only among boys in SEAR.

Findings from the present study support previous work in this area showing associations between food insecurity and unwanted sexual contact. Specifically, it was found that food insecurity was significantly associated with unwanted sexual contact (OR 1.05, 95% CI 1.02, 1.08) among Ghanaian adolescents (Masa et al., 2019), and risky sexual behavior among women living with HIV (Chop et al., 2017). A number of mechanisms may explain the relationship between food insecurity and sexual intercourse, non-condom use, and multiple sexual partners observed in the present study. First, when considering the association between food insecurity and risky sexual behavior from a theoretical perspective, one could argue that social factors such as gender, stigma, poverty and education in certain constellations are structural drivers that could lead to food insecurity, which in turn could cause anxiety, alienation, and poor coping that may consequently lead to risky sexual behavior. Indeed, these issues have been shown in studies on HIV risk and may also apply to food insecurity and risky sexual behavior (Weiser et al, 2011).

Second, it is possible that female adolescents (specifically) may engage in sexual activity with their partners due to reliance on male partners for food. This has previously been shown to be the case among females from Uganda (Miller et al., 2011). Indeed, in the same study, it

was reported by some women that their male sexual partners would deny food sources in order to control the circumstances around sex, including the timing. Moreover, this lack of control prevented women from successfully negotiating condom use. Work by the anthropologist Paola Tabet terms this scenario “affective economic transactions” where sexual intercourse is considered as a value in a broader exchange. For example, females in some cultures may not "desire" to have sex but they decide to have sex because they need to eat (Trachman, 2009). Third, it is possible that young people may engage in sexual activity, particularly age-disparate sex, to manage physical and emotional consequences of not having enough food to eat (Masa et al., 2019).

Alternatively, food insecurity may also be a proxy of broader precariousness and this may negatively influence the ability of young people to think about risk aversion or long-term consequences of risky behaviors. Furthermore, young people who remain without adequate access to food may become less concerned about the future and more worried about immediate satisfaction of their basic needs. A further explanation may be that those who experience food insecurity also have a higher prevalence of mental health complications. Indeed, it has been hypothesized that poor nutrition, stress, and shame linked to food insecurity may lead to increased risk for mental health problems (Althoff, Ametti, & Bertmann, 2016; Koyanagi et al., 2019). Importantly, mental health problems have been shown to be associated with risky sexual behavior (Bennett, & Bauman, 2000) and this is particularly true for adolescent populations

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1118255/>

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC27440/>. Moreover, sexual risk taking usually begins during adolescence <https://www.who.int/news-room/fact-sheets/detail/adolescent-mental-health>. All these hypotheses underline the necessity for protection and

implementation of basic human rights, such as access to adequate living standards, employment and food, which are the prerequisite for achieving sexual rights leading to the attainment and maintenance of sexual health globally (Kismödi et al., 2017).

It is important to note here that the present analyses found an association between food insecurity and non-condom use in the overall sample and in boys but not girls. Interestingly, other research has found contradictory findings. For example, one study in a sample of 261 young men and women from Urban Kenya found that food insufficiency was associated with non-condom use in women but not men (Davidoff-Gore, Luke, & Wawire, 2011). It is not clear why these differing results exist and there is currently little research on gender-specific correlates of non-condom use in adolescents. We encourage future epidemiological investigation in this area.

The reason why an association was only found between food insecurity and multiple sexual partners in SEAR is not known. Moreover, an association between food insecurity and non-condom use was found in the AMR and WPR but not in AFR and SEAR. A cultural comparison of differences in associations between hunger and sexual behaviors is beyond the scope of this manuscript and future anthropological work is required to shed light on the differences. However, previous studies have shown a gender bias in food insecurity, as boys may be more preferentially treated next to girls in terms of food provision, especially in low-income countries (Hadley et al., 2008). We would hypothesize that the same might be true in more affluent countries, however, the difference may be more directed at marginalized populations or based on social differences rather than gender in this context.

It is also important to consider the findings of the present analyses in the context of current circumstances, at the time of writing this paper. The COVID-19 outbreak was declared by the World Health Organization (WHO) as a global pandemic in March 2020. The number of confirmed cases is increasing worldwide and after Asian and European regions, a steep increase is now being observed in low-income countries (WHO, 2020). Reports are suggesting that the COVID-19 pandemic is having a profound impact on the economy with predictions that the majority of countries will enter a recession in 2020 and even advanced economies are projected to shrink by 7% (World Bank, 2020). As a direct result, it is likely that a greater number of households globally will suffer from food insecurity, amplifying the findings observed in the present study.

A clear strength of the present study is the large sample of adolescents across 53 countries and the investigation of the novel association between food insecurity and sexuality parameters. Despite this, findings from the present study must be interpreted in light of its limitations. First, the study was cross-sectional in nature and thus the direction of the association cannot be established, although it is unlikely that sexual behaviour drives food insecurity. Nonetheless, longitudinal research examining these relationships is warranted. Second, questions on food insecurity (hunger) used in the present study have not been validated. However, a brief hunger screening tool based on a similar single question showed 85% sensitivity and 80% specificity compared with the Household Food Security Scale (Kleinman et al., 2007). A measure of wealth was not available in the current dataset, and it is possible that poverty is partly responsible for the associations observed in the present study. We analyzed all collected variables on sexual behavior and food insecurity in the GSHS. However, it would be beneficial for future studies to collect data on the variables studied in the present analyses as well as other variables such as, for example, engaging in sexual

activity whilst intoxicated and same sex relations. Finally, it is also important to note that for cases where we note statistical significance in one gender but not the other, there were overlaps in the 95% confidence intervals, suggesting that the difference between genders may not signify genuine differences.

In conclusion, in this large global sample of adolescents, we found that the prevalence of food insecurity is high and that food insecurity was associated with higher odds of ever having sexual intercourse, non-condom use at last sexual encounter, and having multiple sexual partners in some, but not all regions. Although causality could not be established due to the cross-sectional nature of the data, the mere co-existence of early sexual activity or non-condom use and food insecurity may be an unrecognized public health problem as all are associated with adverse health outcomes. For example, food insecurity is associated with many unfavorable health outcomes such as increased risk of anemia (Moradi, Arghavani, Issah, Mohammadi, & Mirzaei, 2018), overweight and obesity (Moradi et al., 2019), child stunting, and low birth weight in infants (Maitra, 2018) and has been shown to be associated with behaviors that are detrimental to both physical and mental health, such as substance abuse (Whittle et al., 2019), smoking (Kim-Mozeleski et al., 2019), and lower levels of physical activity (To, Frongillo, Gallegos, & Moore, 2014). On the other hand, sexual intercourse in adolescence carries risks for sexually transmitted diseases and adolescent pregnancy. Multidimensional government programs and policies should simultaneously address poverty, inequality, and food insecurity in order to reduce risky sexual behavior, even in very young adolescents. Increasing individual resources, including access to food and educational and potentially work opportunities, could prove to be effective strategies for decreasing risky sexual behavior in young adolescents. Indeed, such strategies could decrease

the need to rely on sexual relationships for economic support while simultaneously increasing individuals' negotiating power to engage in safe sexual practice.

Conflicts of Interest: None.

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Data availability statement: Data are available through

<https://www.who.int/ncds/surveillance/gshs/en/>

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Table 1

Table 1 Survey characteristics

Region	Country	Year	Response rate (%)	N
AFR	Benin	2016	78	2536
	Botswana	2005	95	2197
	Ghana	2012	82	1648
	Kenya	2003	84	3691
	Malawi	2009	94	2359
	Mauritius	2011	82	2168
	Mozambique	2015	80	1918
	Namibia	2013	89	4531
	Senegal	2005	60	3154
	Seychelles	2015	82	2540
	Swaziland	2003	96	7341
	Tanzania	2014	87	3793
	Uganda	2003	69	3215
	Zambia	2004	70	2257
AMR	Antigua & Barbuda	2009	67	1266
	Argentina	2012	71	28368
	Bahamas	2013	78	1357
	Barbados	2011	73	1629
	Belize	2011	88	2112
	Bolivia	2012	88	3696
	Cayman Islands	2007	79	1299
	Chile	2013	60	2049
	Costa Rica	2009	72	2679
	Curaçao	2015	83	2765
	Dominica	2009	84	1642
	El Salvador	2013	88	1915
	Grenada	2008	78	1542
	Guatemala	2015	82	4374
	Guyana	2010	76	2392
	Honduras	2012	79	1779
	Peru	2010	85	2882
	St. Vincent & the Grenadines	2007	84	1333
	St. Lucia	2007	82	1276
	Suriname	2009	89	1698
Trinidad & Tobago	2011	90	2811	
Uruguay	2012	77	3524	
SEAR	Bangladesh	2014	91	2989
	East Timor	2015	79	3704
	Indonesia	2015	94	11142
	Nepal	2015	69	6529
	Thailand	2015	89	5894
WPR	Brunei Darussalam	2014	65	2599
	Cambodia	2013	85	3806
	Fiji	2016	79	3705
	French Polynesia	2015	70	3216
	Kiribati	2011	85	1582
	Laos	2015	70	3683
	Malaysia	2012	89	25507
	Mongolia	2013	88	5393
	Samoa	2011	79	2418
	Tuvalu	2013	90	943
Vanuatu	2011	72	1119	
Vietnam	2013	96	3331	

Abbreviation: AFR African Region; AMR Region of the Americas; SEAR South-East Asia Region; WPR Western Pacific Region

Table 2

Table 2 Prevalence of sexual intercourse, condom non-use, multiple sexual partners, and food insecurity by country

Region	Country	Sexual	Condom	Multiple sex	Food insecurity	
		Intercourse (%)	non-use ^{a,b} (%)	partners ^{a,c} (%)	Moderate (%)	Severe (%)
AFR	Benin	53.4	51.4	65.0	39.3	18.4
	Botswana	23.6	29.9	47.2	51.5	14.0
	Ghana	33.3	53.4	54.2	49.7	15.2
	Kenya	36.7	55.0	NA	47.4	14.7
	Malawi	23.2	36.2	39.9	47.3	18.5
	Mauritius	22.0	56.0	50.9	21.7	3.7
	Mozambique	57.4	24.7	57.2	37.4	11.3
	Namibia	53.7	23.3	59.5	43.5	9.9
	Senegal	25.4	40.3	61.9	36.1	12.2
	Seychelles	40.4	48.7	65.3	31.3	12.5
	Swaziland	11.5	54.6	52.8	42.9	9.7
	Tanzania	20.0	63.9	52.0	19.2	6.7
	Uganda	28.5	36.5	51.2	45.4	9.3
	Zambia	44.7	49.4	59.9	53.9	28.7
AMR	Antigua & Barbuda	36.3	31.8	68.7	36.8	7.4
	Argentina	41.6	23.8	57.9	31.7	3.9
	Bahamas	28.2	40.1	61.2	40.0	6.9
	Barbados	34.8	35.9	59.9	38.1	4.6
	Belize	24.8	31.1	66.4	30.7	7.2
	Bolivia	26.1	41.0	52.0	53.2	8.6
	Cayman Islands	29.0	28.2	63.2	38.4	5.1
	Chile	37.8	47.0	54.1	25.8	1.8
	Costa Rica	24.1	41.6	57.9	18.8	1.4
	Curaçao	38.5	45.0	57.4	21.4	3.8
	Dominica	47.8	35.1	69.6	30.0	5.7
	El Salvador	22.7	28.3	54.1	30.6	3.6
	Grenada	30.8	42.0	63.3	36.1	8.1
	Guatemala	19.7	43.5	63.1	34.4	3.2
	Guyana	32.7	31.9	57.8	38.0	7.8
	Honduras	25.3	32.9	48.5	32.8	3.9
	Peru	19.7	35.8	51.3	49.0	3.2
	St. Lucia	27.4	45.9	66.5	37.8	6.5
	St. Vincent & the Grenadines	30.3	40.6	68.6	33.8	7.0
	Suriname	39.4	27.5	58.8	28.2	10.6
Trinidad & Tobago	26.1	44.1	61.5	40.6	6.4	
Uruguay	34.2	18.2	53.2	21.9	1.5	
SEAR	Bangladesh	9.3	42.1	NA	48.3	13.1
	East Timor	26.4	46.8	54.4	40.0	11.7
	Indonesia	5.3	72.0	60.2	51.1	4.1
	Nepal	20.8	40.8	60.5	28.5	4.7
	Thailand	18.6	35.0	56.0	50.1	3.9
WPR	Brunei Darussalam	11.3	62.3	54.6	54.8	6.7
	Cambodia	11.9	39.3	46.9	48.7	6.3
	Fiji	20.7	52.6	59.3	48.7	11.4
	French Polynesia	40.9	53.0	55.1	53.7	11.1
	Kiribati	24.2	74.0	53.0	54.8	12.8
	Laos	15.2	37.1	56.3	48.2	1.2
	Malaysia	8.3	70.2	52.2	54.9	4.9
	Mongolia	15.3	44.6	51.6	35.3	1.9
	Samoa	57.5	44.2	69.0	44.9	36.2
	Tuvalu	19.0	55.3	62.2	45.8	7.0
Vanuatu	12.9	34.2	46.2	46.0	5.9	

Vietnam

6.5

46.8

31.5

51.4

1.1

Abbreviation: AFR African Region; AMR Region of the Americas; SEAR South-East Asia Region; WPR Western Pacific Region; % percentage

^a Restricted to those who ever had sexual intercourse.

^b At last sexual intercourse.

^c Multiple sex partners referred to ≥ 2 partners.

Table 3

Table 3 Association of moderate and severe food insecurity with sexual intercourse estimated by meta-analysis based on country-wise estimates

	Overall		Boys		Girls	
	OR (95%CI)	<i>I</i> ²	OR (95%CI)	<i>I</i> ²	OR (95%CI)	<i>I</i> ²
<i>Moderate food insecurity vs. no food insecurity</i>						
Overall	1.14 (1.08-1.20)	37.6	1.09 (1.02-1.16)	36.1	1.20 (1.13-1.29)	29.9
AFR	1.16 (1.02-1.32)	57.4	1.19 (1.03-1.37)	47.1	1.12 (0.95-1.32)	37.3
AMR	1.10 (1.03-1.18)	30.0	1.01 (0.92-1.10)	24.3	1.21 (1.09-1.35)	40.4
SEAR	1.22 (1.02-1.46)	56.5	1.15 (0.98-1.35)	10.8	1.33 (0.97-1.83)	63.9
WPR	1.15 (1.06-1.24)	0.0	1.09 (0.97-1.22)	19.7	1.23 (1.10-1.37)	0.0
<i>Severe food insecurity vs. no food insecurity^a</i>						
Overall	1.51 (1.36-1.67)	48.8	1.42 (1.26-1.59)	33.1	1.63 (1.46-1.83)	19.6
AFR	1.37 (1.18-1.59)	33.3	1.30 (1.09-1.55)	21.5	1.52 (1.26-1.83)	19.3
AMR	1.38 (1.19-1.61)	31.8	1.30 (1.08-1.57)	20.1	1.52 (1.26-1.84)	15.1
SEAR	1.92 (1.41-2.61)	43.6	1.51 (1.16-1.95)	2.3	2.41 (1.51-3.86)	35.8
WPR	1.76 (1.37-2.27)	63.9	1.82 (1.34-2.48)	50.7	1.77 (1.44-2.17)	0.0

Abbreviation: OR Odds ratio; CI Confidence interval; AFR African Region; AMR Region of the Americas; SEAR South-East Asia Region; WPR Western Pacific Region

Statistically significant associations (P<0.05) are highlighted in bold font.

Estimates were obtained by combining country-wise estimates adjusted for age, sex (only overall sample), and alcohol use into a meta-analysis with random effects.

^a Estimates for Vietnam could not be obtained due to small numbers. This was also the case only for girls in Tuvalu.

Table 4

Table 4 Association between any food insecurity and condom non-use or multiple sex partners estimated by meta-analysis based on country-wise estimates

	Overall		Boys		Girls	
	OR (95%CI)	<i>I</i> ²	OR (95%CI)	<i>I</i> ²	OR (95%CI)	<i>I</i> ²
<i>Condom non-use^a</i>						
Overall	1.19 (1.09-1.30)	39.1	1.22 (1.11-1.35)	28.8	1.14 (1.00-1.30)	27.3
AFR	1.02 (0.87-1.19)	36.3	1.00 (0.85-1.18)	24.3	1.04 (0.84-1.29)	4.0
AMR	1.31 (1.19-1.45)	19.6	1.39 (1.24-1.55)	0.0	1.20 (0.97-1.49)	53.3
SEAR	0.80 (0.47-1.37)	48.5	0.89 (0.51-1.58)	42.3	0.75 (0.42-1.35)	0.0
WPR	1.31 (1.08-1.59)	23.3	1.35 (1.05-1.73)	28.3	1.25 (0.96-1.63)	0.0
<i>Multiple sex partners^b</i>						
Overall	1.02 (0.96-1.08)	0.0	0.94 (0.86-1.03)	4.1	1.10 (0.99-1.23)	11.9
AFR	1.05 (0.92-1.20)	13.1	0.94 (0.78-1.14)	24.3	1.20 (1.00-1.45)	0.0
AMR	1.00 (0.92-1.09)	0.0	0.94 (0.84-1.06)	0.0	1.04 (0.88-1.23)	24.8
SEAR	1.11 (0.85-1.45)	0.0	1.48 (1.01-2.16)	0.0	0.66 (0.35-1.25)	21.6
WPR	0.96 (0.82-1.11)	0.0	0.83 (0.69-1.01)	0.4	1.35 (0.96-1.89)	18.6

Abbreviation: OR Odds ratio; CI Confidence interval; AFR African Region; AMR Region of the Americas; SEAR South-East Asia Region; WPR Western Pacific Region

Analysis is restricted to those who ever had sexual intercourse.

Statistically significant associations ($P < 0.05$) are highlighted in bold font.

Estimates were obtained by combining country-wise estimates adjusted for age, sex (only overall sample), and alcohol use into a meta-analysis with random effects.

^a At last sexual intercourse. Estimates for Tuvalu were not available only for girls due to small numbers.

^b Multiple sexual partners referred to ≥ 2 partners. Bangladesh and Kenya are not included due to lack of data.

Supplementary material

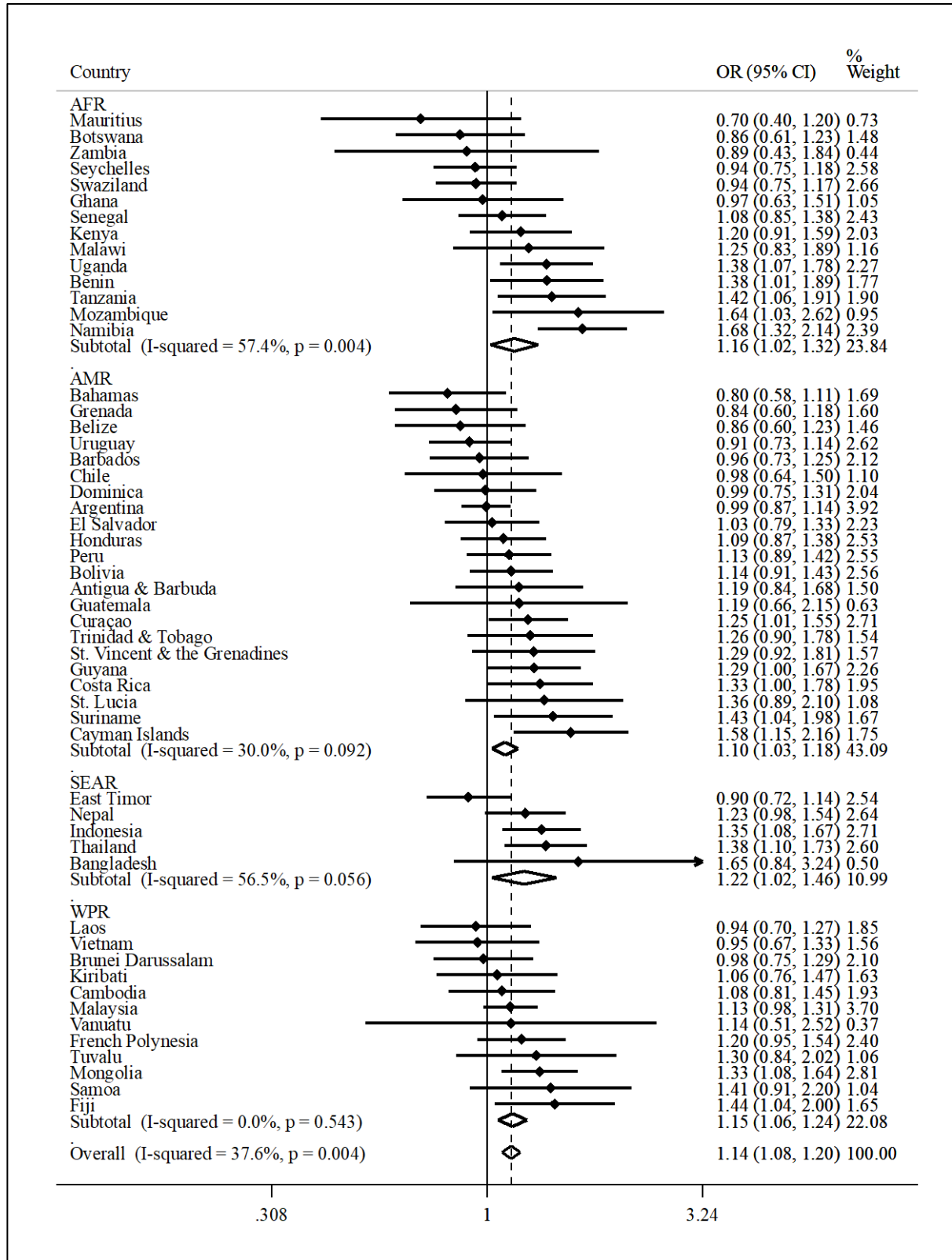


Figure S1

Association between moderate food insecurity (vs. no food insecurity) and sexual intercourse estimated by multivariable logistic regression

Abbreviation: OR Odds ratio; CI Confidence interval; AFR African Region; AMR Region of the Americas; SEAR South-East Asia Region; WPR Western Pacific Region

Models are adjusted for sex, age, and alcohol consumption.

Overall estimate was obtained by meta-analysis with random effects.

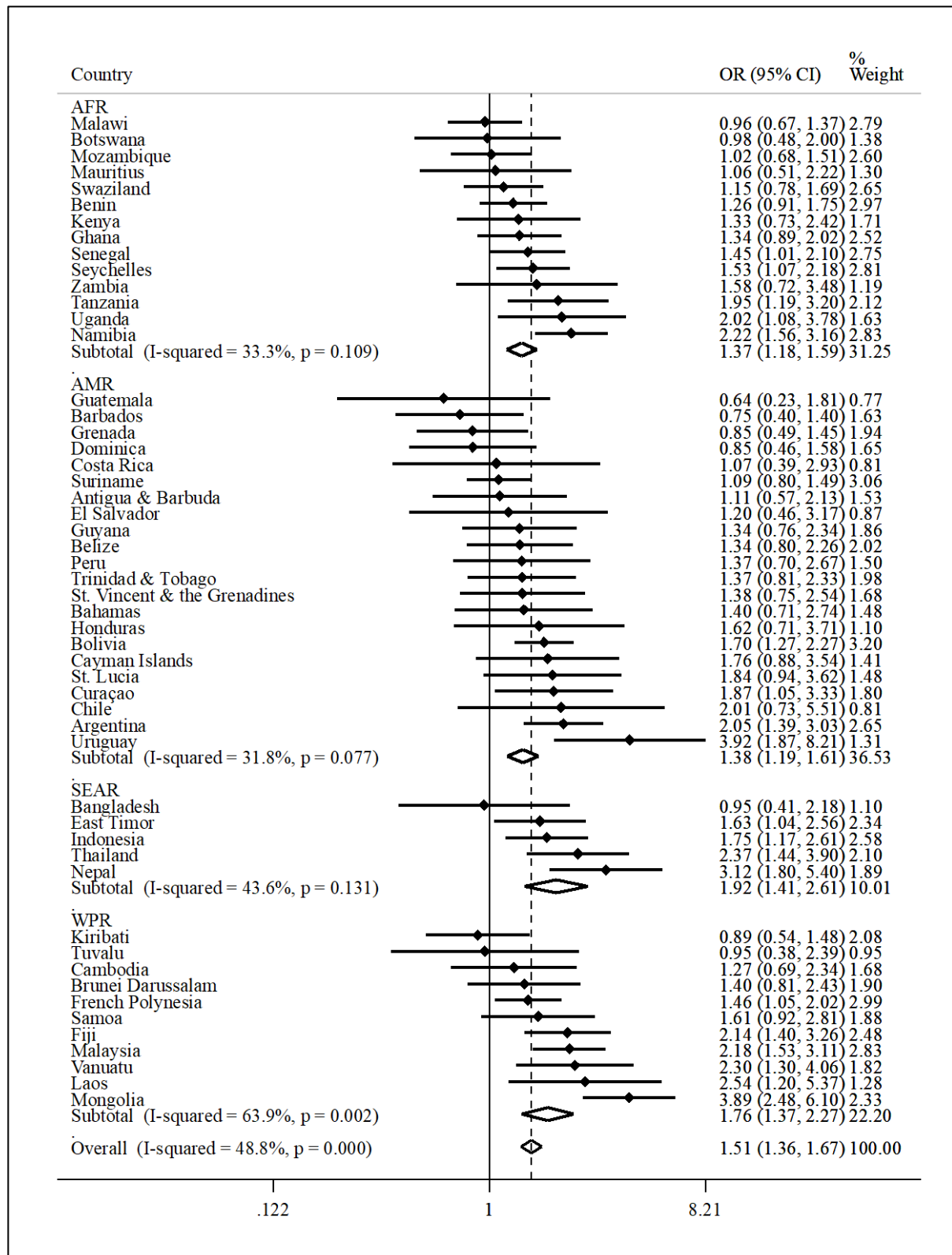


Figure S2

Association between severe food insecurity (vs. no food insecurity) and sexual intercourse estimated by multivariable logistic regression

Abbreviation: OR Odds ratio; CI Confidence interval; AFR African Region; AMR Region of the Americas; SEAR South-East Asia Region; WPR Western Pacific Region

Models are adjusted for sex, age, and alcohol consumption.
Overall estimate was obtained by meta-analysis with random effects.

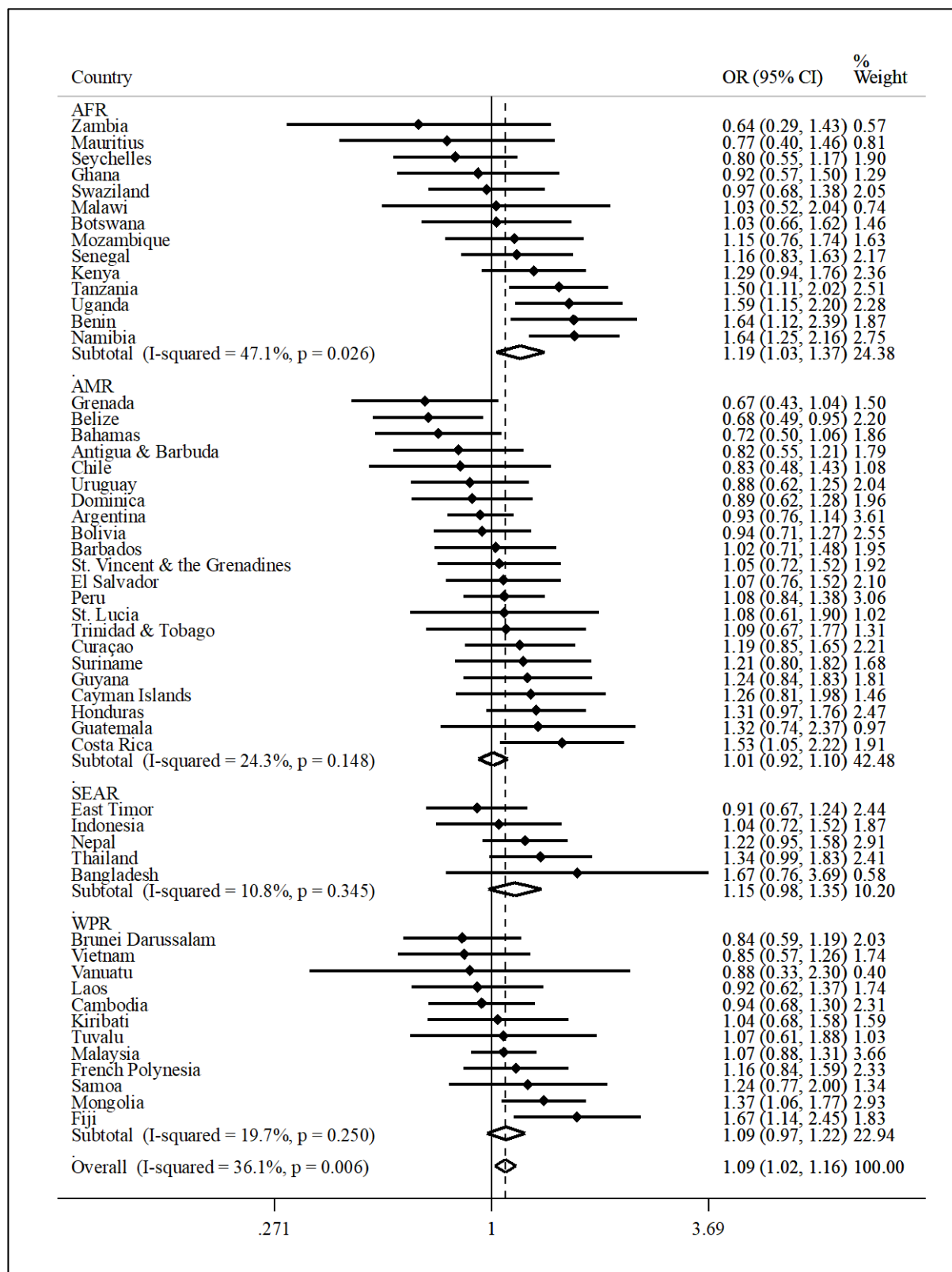


Figure S3

Association between moderate food insecurity (vs. no food insecurity) and sexual intercourse among boys estimated by multivariable logistic regression

Abbreviation: OR Odds ratio; CI Confidence interval; AFR African Region; AMR Region of the Americas; SEAR South-East Asia Region; WPR Western Pacific Region

Models are adjusted for age and alcohol consumption.
Overall estimate was obtained by meta-analysis with random effects.

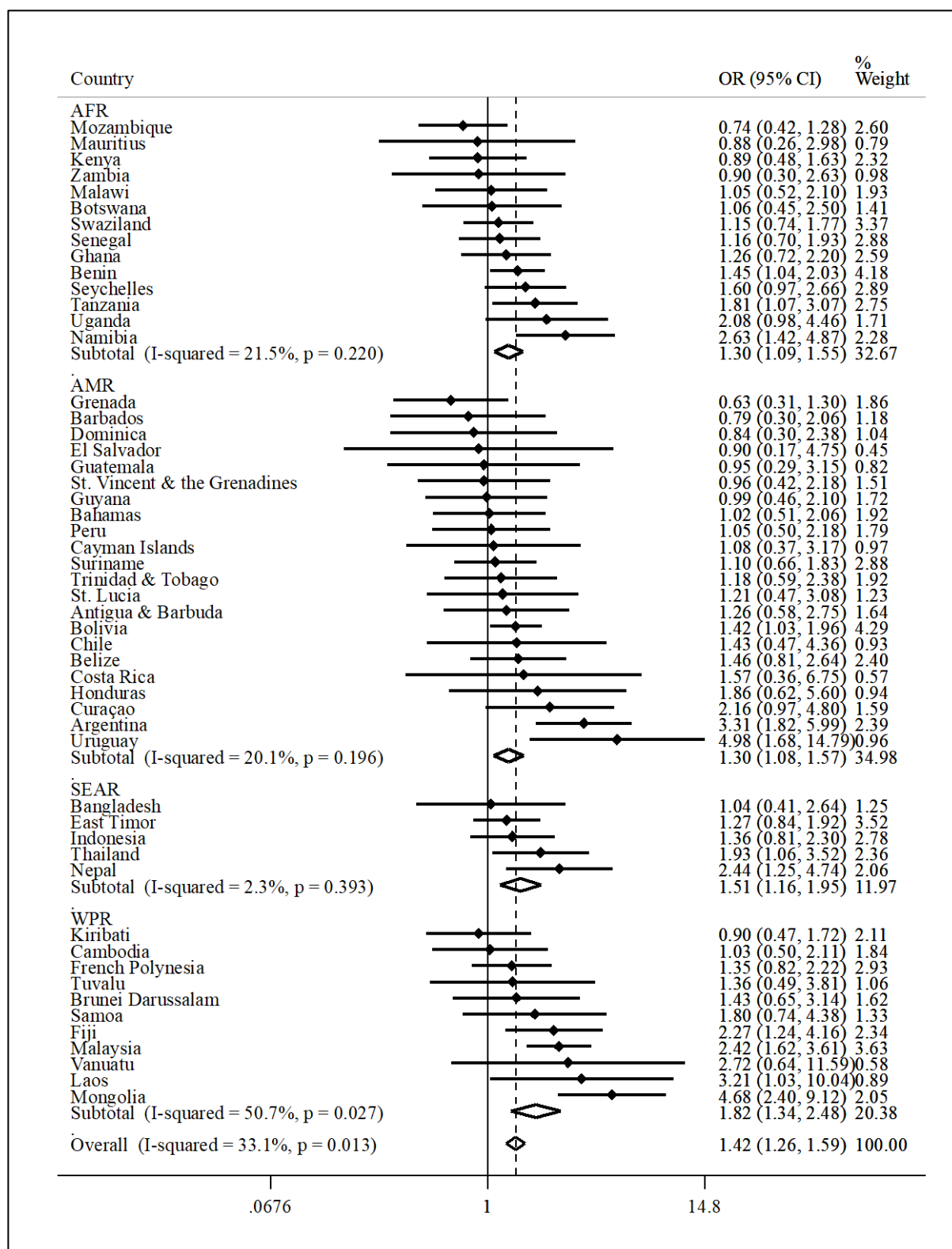


Figure S4

Association between severe food insecurity (vs. no food insecurity) and sexual intercourse among boys estimated by multivariable logistic regression

Abbreviation: OR Odds ratio; CI Confidence interval; AFR African Region; AMR Region of the Americas; SEAR South-East Asia Region; WPR Western Pacific Region

Models are adjusted for age and alcohol consumption.

Overall estimate was obtained by meta-analysis with random effects.

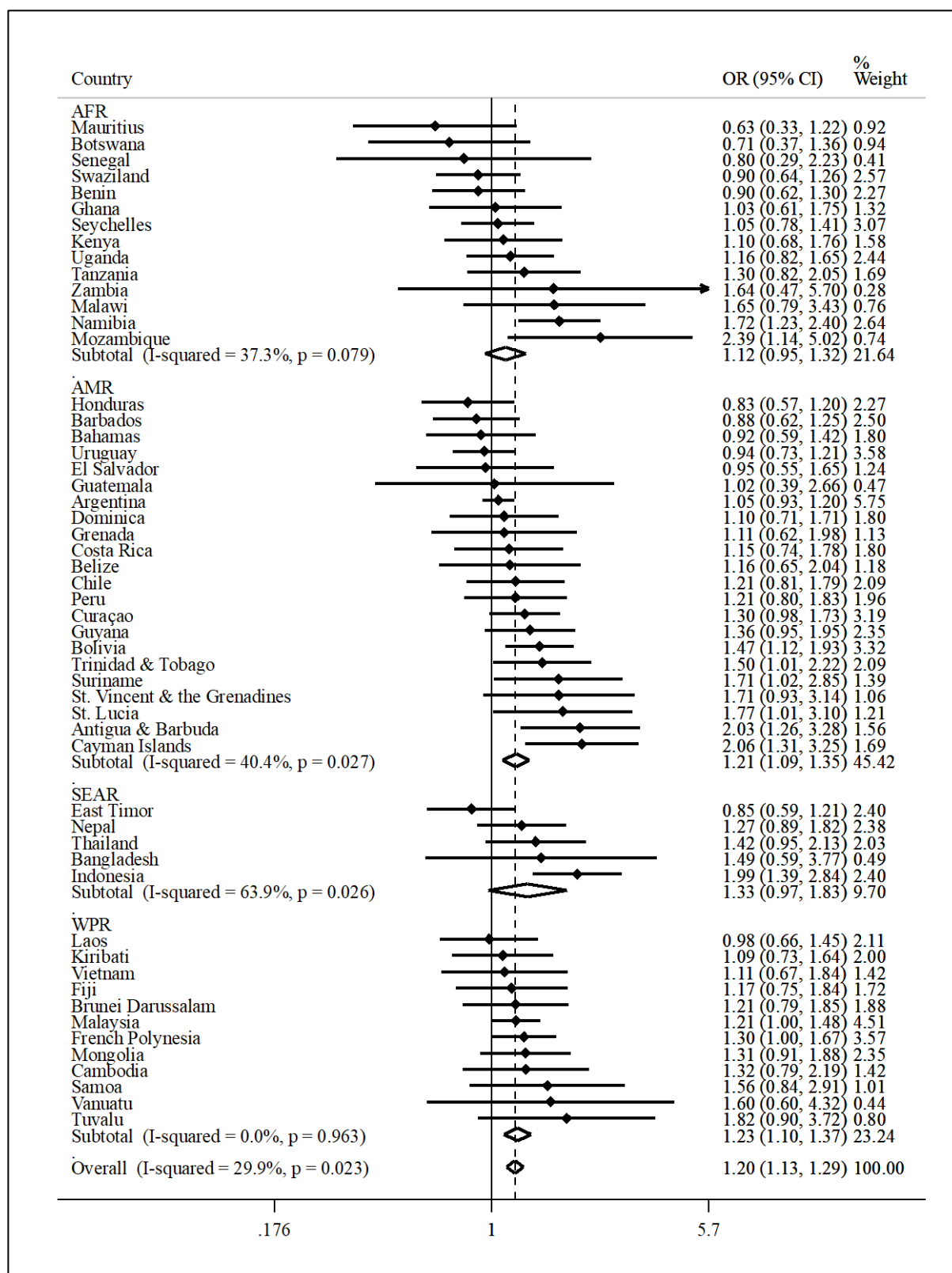


Figure S5

Association between moderate food insecurity (vs. no food insecurity) and sexual intercourse among girls estimated by multivariable logistic regression

Abbreviation: OR Odds ratio; CI Confidence interval; AFR African Region; AMR Region of the Americas; SEAR South-East Asia Region; WPR Western Pacific Region

Models are adjusted for age and alcohol consumption.
Overall estimate was obtained by meta-analysis with random effects.

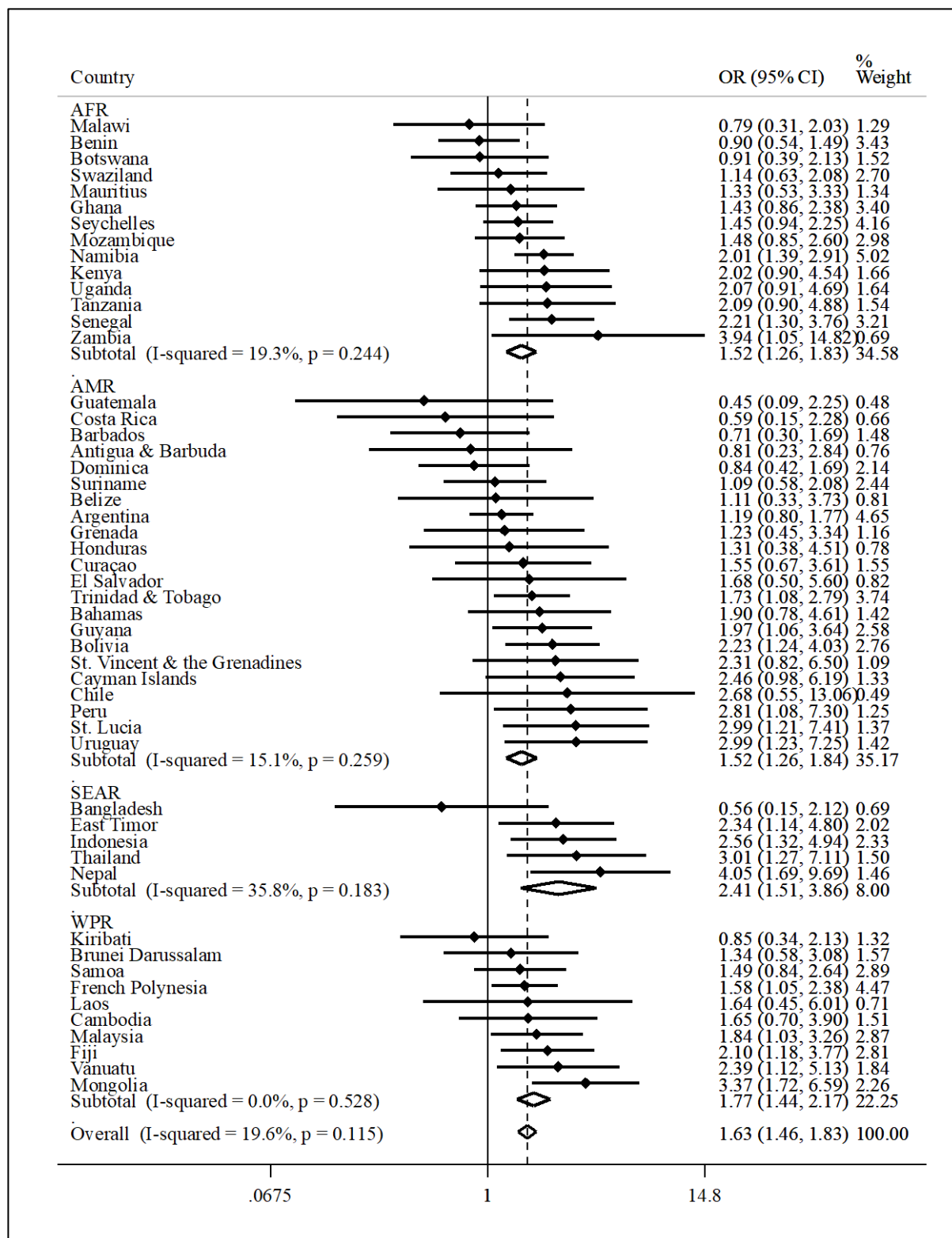


Figure S6

Association between severe food insecurity (vs. no food insecurity) and sexual intercourse among girls estimated by multivariable logistic regression

Abbreviation: OR Odds ratio; CI Confidence interval; AFR African Region; AMR Region of the Americas; SEAR South-East Asia Region; WPR Western Pacific Region
Models are adjusted for age and alcohol consumption.

Overall estimate was obtained by meta-analysis with random effects.

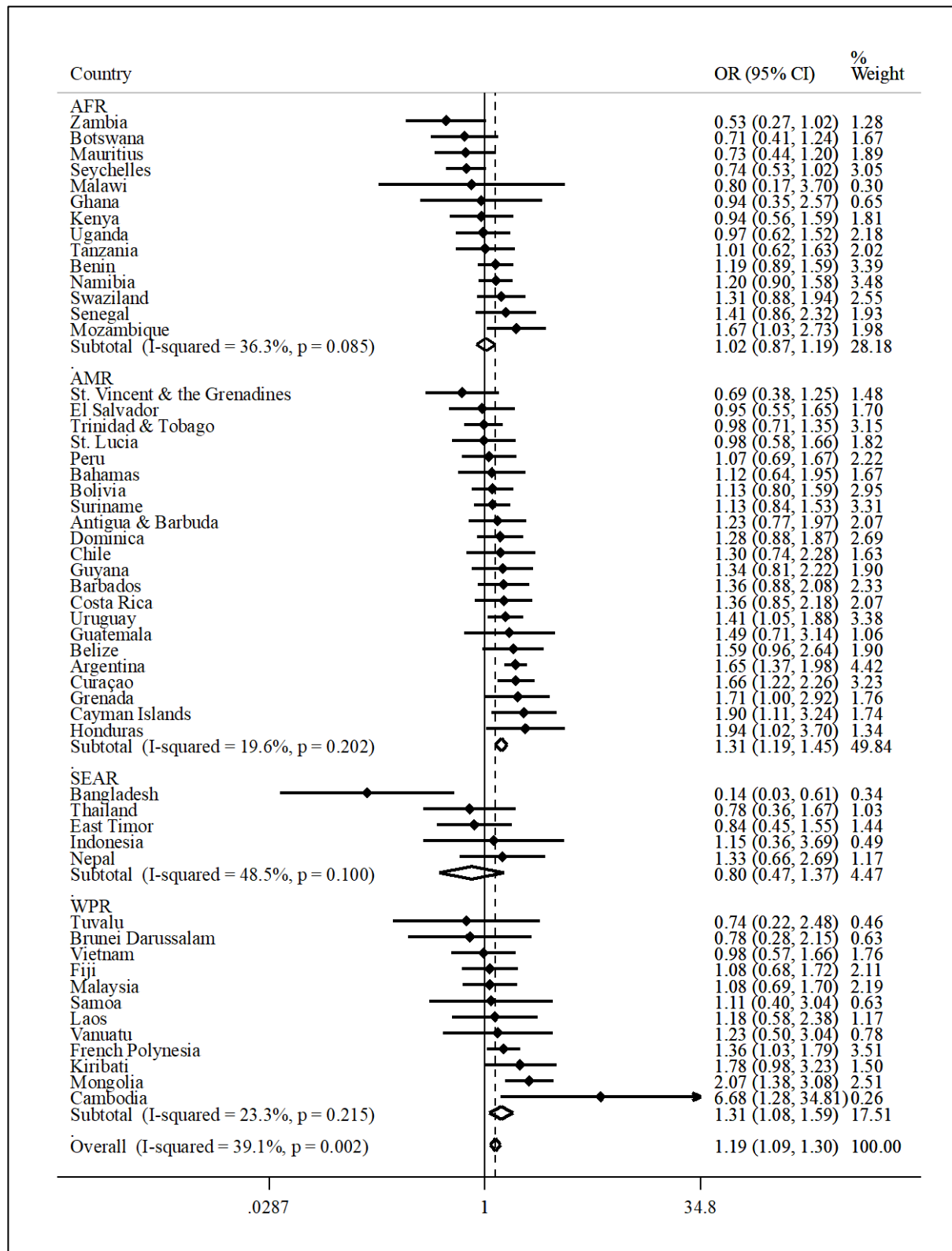


Figure S7

Association between any food insecurity (vs. no food insecurity) and condom non-use estimated by multivariable logistic regression

Abbreviation: OR Odds ratio; CI Confidence interval; AFR African Region; AMR Region of the Americas; SEAR South-East Asia Region; WPR Western Pacific Region

Models are adjusted for sex, age, and alcohol consumption.
Overall estimate was obtained by meta-analysis with random effects.
Analysis is restricted to those who ever had sexual intercourse.

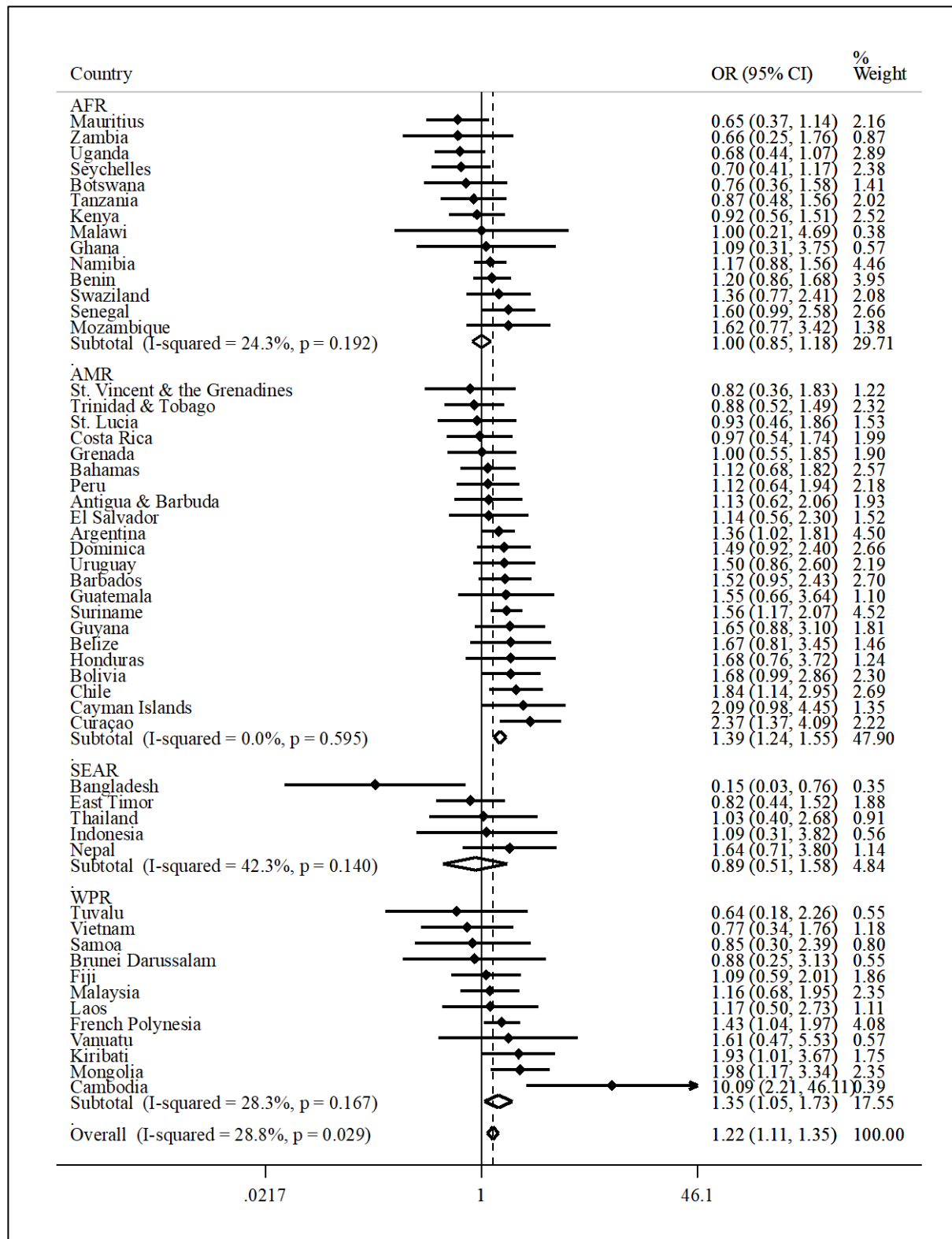


Figure S8

Association between any food insecurity (vs. no food insecurity) and condom non-use among boys estimated by multivariable logistic regression

Abbreviation: OR Odds ratio; CI Confidence interval; AFR African Region; AMR Region of the Americas;

SEAR South-East Asia Region; WPR Western Pacific Region

Models are adjusted for age and alcohol consumption.

Overall estimate was obtained by meta-analysis with random effects.
Analysis is restricted to those who ever had sexual intercourse.

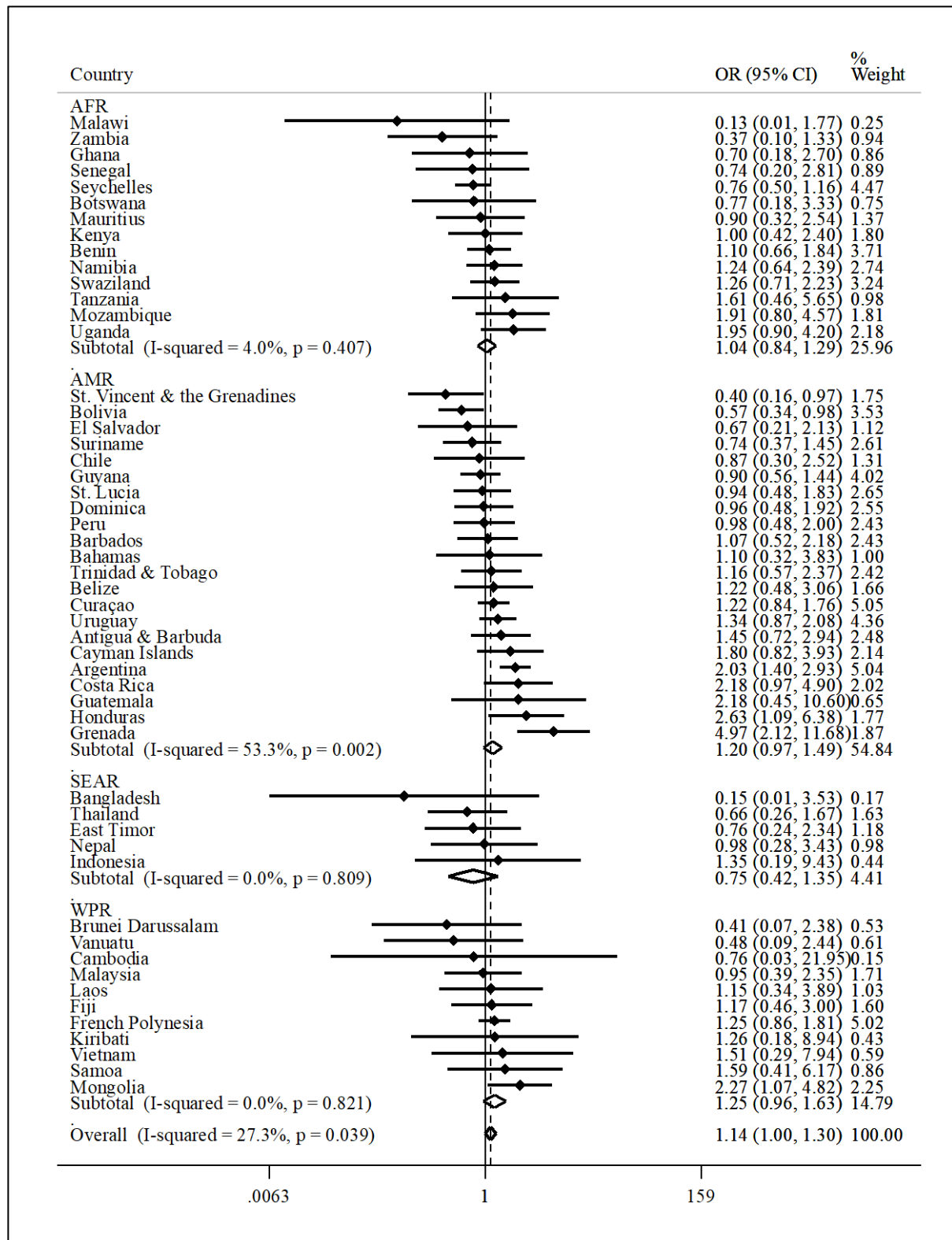


Figure S9

Association between any food insecurity (vs. no food insecurity) and condom non-use among girls estimated by multivariable logistic regression

Abbreviation: OR Odds ratio; CI Confidence interval; AFR African Region; AMR Region of the Americas;

SEAR South-East Asia Region; WPR Western Pacific Region

Models are adjusted for age and alcohol consumption.

Overall estimate was obtained by meta-analysis with random effects.
Analysis is restricted to those who ever had sexual intercourse.

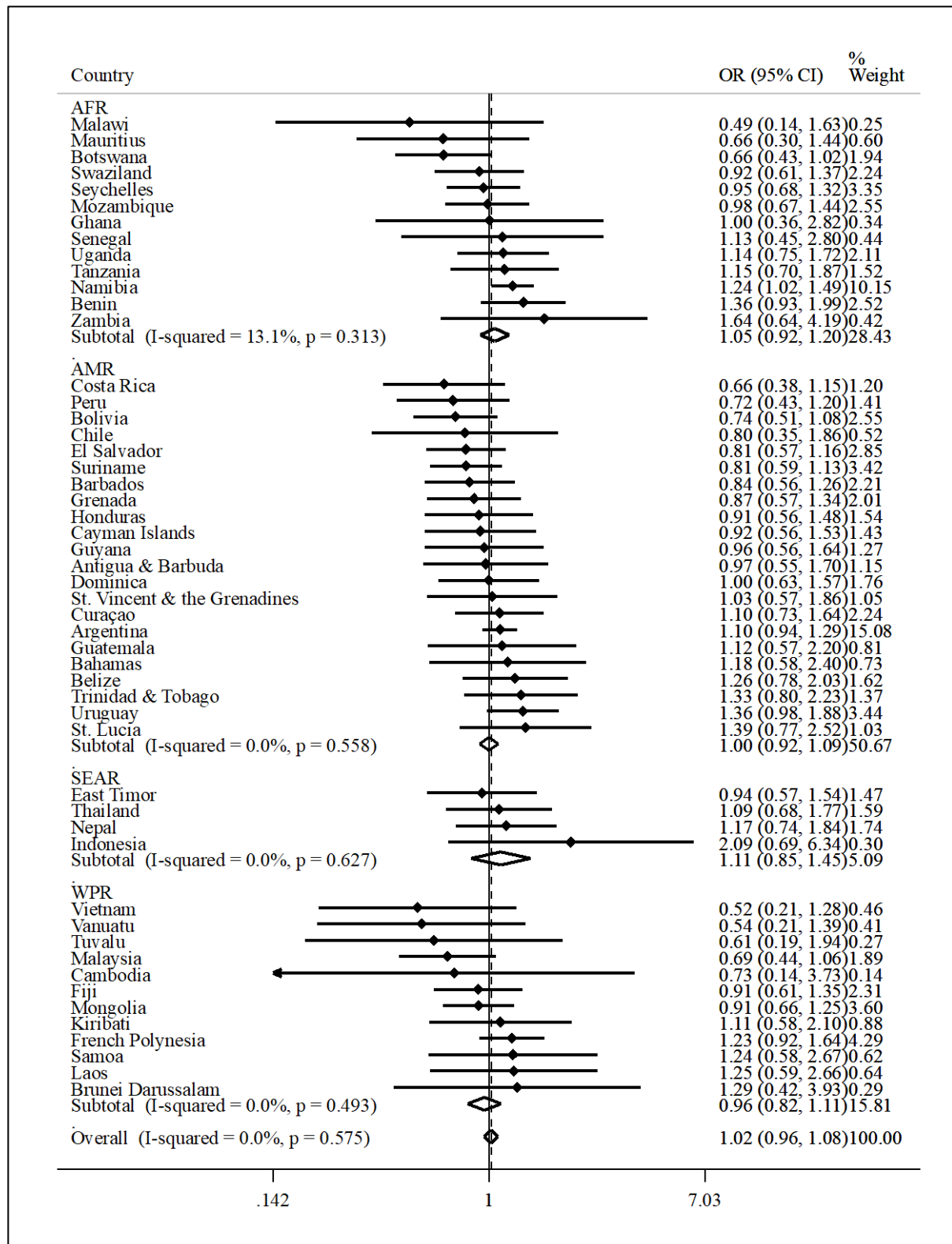


Figure S10

Association between any food insecurity (vs. no food insecurity) and multiple sex partners estimated by multivariable logistic regression

Abbreviation: OR Odds ratio; CI Confidence interval; AFR African Region; AMR Region of the Americas;

SEAR South-East Asia Region; WPR Western Pacific Region

Models are adjusted for sex, age, and alcohol consumption.

Overall estimate was obtained by meta-analysis with random effects.
Analysis is restricted to those who ever had sexual intercourse.

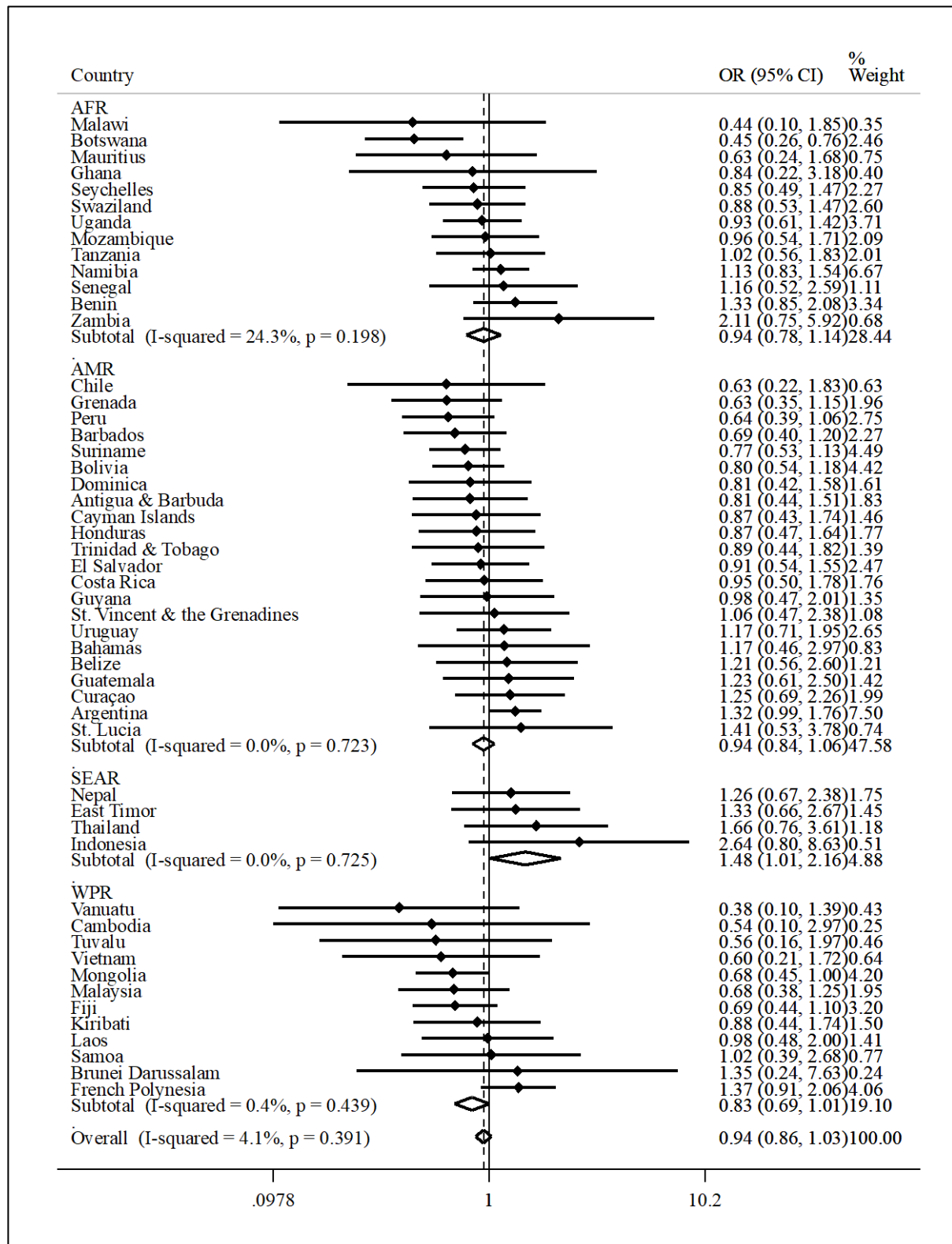


Figure S11

Association between any food insecurity (vs. no food insecurity) and multiple sex partners among boys estimated by multivariable logistic regression

Abbreviation: OR Odds ratio; CI Confidence interval; AFR African Region; AMR Region of the Americas;

SEAR South-East Asia Region; WPR Western Pacific Region

Models are adjusted for age and alcohol consumption.

Overall estimate was obtained by meta-analysis with random effects.
Analysis is restricted to those who ever had sexual intercourse.

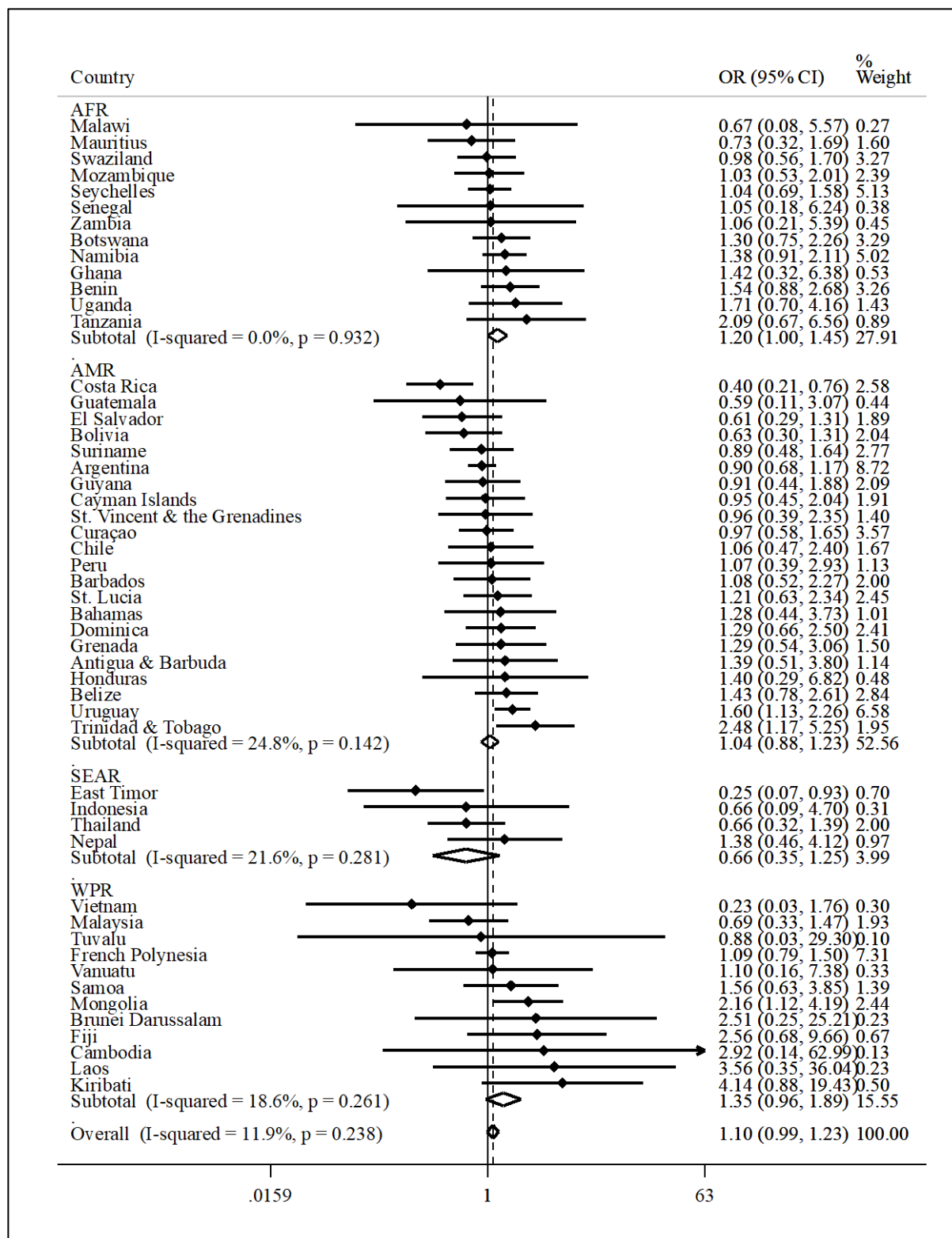


Figure S12

Association between any food insecurity (vs. no food insecurity) and multiple sex partners among girls estimated by multivariable logistic regression

Abbreviation: OR Odds ratio; CI Confidence interval; AFR African Region; AMR Region of the Americas; SEAR South-East Asia Region; WPR Western Pacific Region

Models are adjusted for age and alcohol consumption.

Overall estimate was obtained by meta-analysis with random effects.
Analysis is restricted to those who ever had sexual intercourse.