Overweight and Obesity among Children at Risk of Intellectual Disability in 20 Low and Middle Income Countries

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Competing interests

The authors declare that they have no competing interests.

Authors' contributions

EE conceived of the study, performed the statistical analysis and led on the drafting of the manuscript. AS participated in the design of the study and drafting of the manuscript. Both authors read and approved the final manuscript.

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Abstract

Background: Children with intellectual disability in high income countries are at significantly greater risk of obesity than their non-disabled peers. We aimed to estimate the prevalence of overweight and obesity in 3-4 year old children who are/are not at risk of intellectual disability in low and middle income countries.

Method: Secondary analysis of Round 4 and 5 UNICEF Multiple Indicator Cluster Surveys (MICS) from 20 low and middle income countries that included a total of 83,597 3-4 year old children.

Results: Few differences in risk of overweight or obesity were apparent between 3-4 year old children identified as being at risk/not at risk of intellectual disability in 20 low and middle income countries. In the two countries where statistically significant differences were observed, prevalence of overweight/obesity was *lower* among children at risk of intellectual disability.

Conclusions: These results stand in stark contrast to evidence from high income countries which suggest that children with intellectual disability are at significantly increased risk of obesity when compared to their non-intellectually disabled peers.

Keywords: Intellectual disability, obesity, overweight, low-income countries, children, prevalence

Introduction

Reducing child obesity is an international public health priority (Lobstein *et al.* 2004, World Health Organization 2012, World Health Organization 2015). Reducing the prevalence and inequities in the distribution of child obesity will require developing interventions that are sensitive to the situation of 'high risk' groups of children (World Health Organization 2011). Children with intellectual disability appear to be one such high risk group. The available evidence suggests that children with disabilities generally (Ells *et al.* 2006, McGillivray *et al.* 2013, Public Health England 2014), and children with intellectual disability specifically (Maiano 2011), are at increased risk of overweight and/or obesity. The increased risk of obesity among children with intellectual disability has been reported in a diverse range of high income countries including Australia (De *et al.* 2008, Emerson & Robertson 2010), France (Begarie *et al.* 2013, Salaun & Berthouze-Aranda 2011), Japan (Takeuchi 1994), Korea (Choi *et al.* 2012), Taiwan (Lin *et al.* 2005), the UK (Emerson 2009, Slevin *et al.* 2014, Stewart *et al.* 2009) and the USA (Bandini *et al.* 2015, Foley *et al.* 2014, Fox *et al.* 1985). The only exception to this pattern being one report of lower rates of obesity among children with intellectual disability in Hong Kong (Frey & Chow 2006). Five of these studies report increased risk of overweight and/or obesity in children as young as preschool age (i.e. 2-5 years old) (De *et al.* 2008, Emerson 2009, Emerson & Robertson, 2010, Lin *et al.* 2005, Fox *et al*. 1985).

The existing literature does, however, have two significant limitations. First, the majority of studies have relied on convenience samples (e.g., children attending special schools (Begarie *et al.* 2013, Choi *et al.* 2012, Fox *et al.* 1985, Frey & Chow 2006, Slevin *et al.* 2014, Stewart *et al.* 2009, Takeuchi 1994), children participating in Special Olympics (Foley *et al.* 2014, Lloyd *et al.* 2014, Lloyd *et al.* 2012)) that are unlikely to be representative of the wider population of children with intellectual disability. Second, all studies published to date that have estimated the association between intellectual disability

and overweight/obesity have been undertaken in high income countries. The only study to date that has reported data on the prevalence of obesity among children with intellectual disability, reported that the prevalence of obesity among Special Olympians increased with country income group (Lloyd *et al.* 2014). However, no information on the prevalence of obesity among children without intellectual disability (or in the general population) was reported.

The aims of the present paper are to redress these two deficiencies in the existing evidence-base by: (1) estimating the prevalence of overweight and obesity in early childhood in children at risk/not at risk of intellectual disability in representative samples of children in a range of low and middle income countries; and (2) determining whether any observed between-group differences could plausibly be attributed to between-group differences in household wealth.

Method

We undertook secondary analysis of data collected in Round 4 and 5 of UNICEF's Multiple Cluster Indicators Surveys (MICS, UNICEF 2015). The MICS programme, launched in 1994, sought to generate robust country-specific data on the wellbeing of young children and mothers and formed the basis of measuring progress toward the achievement of the Millennium Development Goals (UNICEF 2015). Following approval of access by UNICEF, data were downloaded from http://mics.unicef.org/ in November 2015. MICS 4 surveys were undertaken between 2009 and 2012 in 56 low and middle income countries, with data available at the time of download for 40 countries. MICS 5 surveys commenced in 2012 and at the time of download had been completed in 25 countries, with data available for 10 countries.

MICS contains a number of questionnaire modules. Data used in the present report were extracted from the household module and the module applied to all children under five living in the household. Details of the sampling procedure used in each country are available at

http://mics.unicef.org/. In the majority of countries cluster sampling methods are used to derive samples representative of the national population of mothers and young children. In all countries sample weights are generated to take into account any biases deriving from the sampling method and household and individual level non-response.

Identification of children at risk of intellectual disability

The child under five module in MICS 4 and 5 contained a ten item module which is used to derive an Early Child Development Index (ECDI). The index is based on selected milestones that children are expected to achieve by ages 3 and 4. The ECDI is calculated as the percentage of children who are developmentally on track in at least three of four domains; literacy-numeracy, physical, social emotional, and learning. We used the five items from the literacy-numeracy and learning domains to identify children who may be considered at risk of intellectual disability.

Literacy-numeracy: Children are defined as being developmentally on track based on: (a) whether they can identify/name at least ten letters of the alphabet; (b) whether they can read at least four simple, popular words; and (c) whether they know the name and recognize the symbols of all numbers from 1 to 10. If at least two of these are true, then in the EDCI the child is considered developmentally on track.

Learning: Children are defined as being developmentally on track based on: (a) if the child follows simple directions on how to do something correctly; and (b) when given something to do, is able to do it independently. If at least one of these is true, then in the EDCI the child is considered developmentally on track.

We identified children as being at risk of intellectual disability if they were reported by their primary caregiver to be unable to complete all five tasks. However, we only included data from

countries that met three criteria: (a) the five items demonstrated a modest degree of internal consistency (alpha >= 0.5); (b) the prevalence of risk of intellectual disability was greater than 1%; and (c) the number of children identified as being at risk of intellectual disability was greater than 50. These inclusion criteria led to the exclusion of data from 17 countries due to: low internal consistency (six countries; Argentina, Barbados, Costa Rica, Moldova, Mongolia, Suriname), low prevalence (Bosnia-Herzegovina, Jamaica, Macedonia, Montenegro, Saint Lucia, Serbia, Ukraine), and/or small samples (Bosnia-Herzegovina, Cuba, Jamaica, Kazakhstan, Kosovo, Lebanon, Macedonia, Montenegro, Saint Lucia, Serbia, Ukraine). A further three countries were excluded as ECDI items were not collected (Afghanistan, Indonesia, Sudan).

Overweight & Obesity

Child weight and height data was collected by direct measurement using anthropometric equipment recommended by UNICEF (UNICEF 2014). These data were available for all but five countries for which we were able to identify children at risk of intellectual disabilities (Belarus, Madagascar, Panama, Somalia, Vietnam). Weight-for-height data were transformed into z scores from the median reference population; WHO growth standards (WHO Multicentre Growth Reference Study Group 2006). Children whose weight-for-height was more than two standard deviations above the median were classified as overweight. Children whose weight-for-height was more than three standard deviations above the median were classified as obese (de Onis *et al.* 2010).

Household Wealth

MICS data is released with a derived wealth index for each household. To construct the wealth index, principal components analysis is performed by using information on the ownership of consumer goods, dwelling characteristics, water and sanitation, and other characteristics that are related to the household's wealth, to generate weights (factor scores) for each of the items used. First, initial factor

scores are calculated for the total sample. Then, separate factor scores are calculated for households in urban and rural areas. Finally, the urban and rural factor scores are regressed on the initial factor scores to obtain the combined, final factor scores for the total sample. This is carried out to minimize the urban bias in the wealth index values. Each household in the total sample is then assigned a wealth score based on the assets owned by that household and on the final factor scores obtained as described above. The survey household population is then ranked according to the wealth score of the household they are living in, and is finally divided into five equal parts (quintiles) from lowest (poorest) to highest (richest). The wealth index is assumed to capture the underlying long-term wealth through information on the household assets, and is intended to produce a ranking of households by wealth, from poorest to richest (Rutstein 2008, Rutstein & Johnson 2004). Household wealth data was available for all 20 countries in which we were able to identify children at risk of intellectual disability and contained weight-for-height data.

Approach to Analysis

Details of the 20 MICS surveys included in our analyses are presented in Table 1. Of the 20 countries, 18 employed sampling frames to generate samples that were representative of the national population of 3-4 year old children. In two countries, sampling frames were employed to generate samples that were representative of particular provinces within the country (Baluchistan in Pakistan and Nyanza in Kenya). The combined samples included information on 83,597 3-4 year old children (14,692 in upper middle income countries, 24,780 in lower middle income countries and 44,125 in low income countries). Risk of intellectual disability was significantly higher in low income countries when compared with middle income countries both overall (19.5% vs 7.3%, $z=51.0$, $p<0.001$) and in the 18 countries employing nationally representative sampling frames (19.8% vs 6.5%, $z=53.6$, $p<0.001$). Per capita Gross National

Income (GNI) corrected for 2011 purchasing power parity in US$ taken from 2014 Human Development Report (United Nations Development Programme 2014).

[Insert Table 1]

In the first stage of analysis we used simple bivariate descriptive statistics to estimate the prevalence of overweight and obesity among 3 and 4 year old children deemed at risk and not at risk of intellectual disability in each participating country. In the second stage of analysis we used multivariate logistic regression to determine the unique strength and statistical significance of the association between risk of intellectual disability controlling for the potentially confounding effects of household wealth by entering wealth quintile data as a categorical variable. All analyses used appropriate country-specific weights to take account of biases in sampling frames.

Results

Table 2 presents estimated prevalence rates, unadjusted and wealth-adjusted risk for overweight and obesity at ages 3 to 4 among children deemed to be at risk and not at risk of intellectual disability.

[Insert Table 2]

In only one of the 20 countries was there a significant difference in wealth adjusted rates of obesity between children at risk/not at risk of intellectual disability, with significantly *lower* rates of obesity among children at risk of intellectual disability being evident in the Province of Baluchistan in Pakistan. Similarly, in only two of the 20 countries was there a significant difference in wealth adjusted rates of overweight or obesity between children at risk/not at risk of intellectual disability, with significantly *lower* rates of overweight/obesity among children at risk of intellectual disability being evident in the Province of Baluchistan in Pakistan and in Malawi.

Discussion

Our results indicated few differences in risk of overweight or obesity between 3 and 4 year old children who were identified as being at risk/not at risk of intellectual disability in 20 low and middle income countries. In the two countries where statistically significant differences were observed, prevalence of overweight/obesity was *lower* among children at risk of intellectual disability. These results stand in stark contrast to evidence from high income countries which suggests that children with intellectual disability are at significantly increased risk of obesity when compared to their non-intellectually disabled peers (Bandini *et al.* 2015, Begarie *et al.* 2013, Choi *et al.* 2012, Foley *et al.* 2014, Maiano 2011, Salaun & Berthouze-Aranda 2011, Slevin *et al.* 2014).

The results of the present study add to current knowledge in two important ways. First, this is the first study to report on rates of obesity and overweight in population-based samples of children at risk/not at risk of intellectual disability in low and middle income countries. As such, it represents one small step in addressing a major bias in knowledge about the wellbeing of people with intellectual disabilities that results from the almost exclusive focus of research on the wellbeing of people with intellectual disabilities in high income countries (Emerson *et al.* 2007, Emerson & Hatton 2014, Tomlinson *et al.* 2014). Second, the discrepancy between the results of the present study and previous studies suggests that country economic status may moderate the association between intellectual disability and obesity.

One possible explanation of the observed discrepancy between the results of the present and previous studies may relate to differences between high income and other countries in the association between poverty/wealth and risk of child obesity. In high income countries child obesity is typically significantly more common among children in poorer families, a pattern that is also becoming evident in lower income countries (Popkin & Gordon-Larsen 2004). In the present study, the association between household wealth and obesity was variable with: no significant association evident in seven countries;

significantly higher rates evident among children from more wealthy families in eight countries; and significantly higher rates evident among children from less wealthy families in five countries. In all instances, however, the effect sizes were very small. Given that risk of intellectual disability is greater among children in poorer families (Emerson 2012, Maulik *et al.* 2011), it is possible that the increased risk of obesity reported among children in high income countries may, in part, be attributable to family socio-economic position rather than intellectual disability per se.

While scant, some research suggests that children with intellectual disability may experience a 'double burden' in that they are at an increased risk of being both overweight and underweight (Lloyd *et al*. 2014, Shabayek, 2003). Further research is needed to not only to estimate the prevalence of non-normal body-mass among children with intellectual disability across economically diverse countries, but also to investigate potential mechanisms, including family socio-economic position, that may account for this disparity.

The primary limitation of the present study lies in our operational definition of 'risk of intellectual disability' being based in primary caregiver report (rather than observation) of child attainment in five areas relating to numeracy, literacy and independence. No information is available on the sensitivity or specificity of this measure in relation to the formal identification of intellectual disability. However, while the overall prevalence rates are higher than the expected prevalence of intellectual disability, prevalence of 'risk of' intellectual disability did vary with country economic status in a similar manner to intellectual disability (Maulik *et al.* 2011).

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References

Bandini L., Danielson M., Esposito L. E., Foley J. T., Fox M. H., Frey G. C., Fleming R. K., Krahn G., Must A., Porretta D. L., Rodgers A. B., Stanish H. I., Urv T. K. Vogel L. C. & Humphries K. (2015) Obesity in children with developmental and/or physical disabilities. *Disability & Health Journal* **8,** 309-316.

Begarie J., Maiano C., Leconte P. & Ninot G. (2013) The prevalence and determinants of overweight and obesity among French youths and adults with intellectual disabilities attending special education schools. *Research in Developmental Disabilities* **34,** 1417-1425.

Choi E., Park H., Ha Y. & Hwang W. J. (2012) Prevalence of Overweight and Obesity in Children with Intellectual Disabilities in Korea. *Journal of Applied Research in Intellectual Disabilities* **25,** 476–483.

de Onis M., Blossner M. & Borghi E. (2010) Global prevalence and trends of overweight and obesity among preschool children. *American Journal of Clinical Nutrition* **92,** 1257-64.

De S., Small J. & Baur L. (2008) Overweight and obesity among children with developmental disabilities. *Journal of Intellectual & Developmental Disability* **33,** 43-47.

Ells L., Lang R., Shield J., Wilkinson J., Lidstone J., Coulton S. & Summerbell C. (2006) Obesity and disability - a short review. *Obesity Reviews* **7,** 341-345.

Emerson E. (2009) Overweight and obesity in 3 and 5 year old children with and without developmental delay. *Public Health* **123,** 130-133.

Emerson E. (2012) Household deprivation, neighbourhood deprivation, ethnicity and the prevalence of intellectual and developmental disabilities. *Journal of Epidemiology and Community Health* **66,** 218-224.

Emerson E., Fujiura G. T. & Hatton C. (2007) International perspectives. In: *Handbook on Developmental Disabilities* (eds S. L. Odom, R. H. Horner, M. Snell & J. Blacher). Guilford Press, New York.

Emerson E. & Hatton C. (2014) *Health Inequalities and People with Intellectual Disabilities.* Cambridge University Press, Cambridge.

Emerson E. & Robertson J. (2010) Obesity in young Australian children with intellectual disabilities or borderline intellectual functioning. *International Journal of Pediatric Obesity* **5,** 320-326.

Foley J. T., Lloyd M. & Temple V. A. (2014) Obesity trends of 8-18 year old Special Olympians: 2005-2010. *Research in Developmental Disabilities* **35,** 705-710.

Fox R. A., Hartney C. W., Rotatori A. F. & Kurpiers E. M. (1985) Incidence of obesity among retarded children. *Education and Training in Mental Retardation* **20,** 175-181.

Frey G. C. & Chow B. (2006) Relationship between BMI, physical fitness, and motor skills in youth with mild intellectual disabilities. *International Journal of Obesity* **30,** 861-867.

Lin J., Yen C., Li C. & Wu J. (2005) Patterns of obesity among children and adolescents with intellectual disabilities in Taiwan. *Journal of Applied Research in Intellectual Disabilities* **18,** 123–129.

Lloyd M., Foley J. T. & Temple V. A. (2014) Body mass index of children and youth with an intellectual disability by country economic status. *Preventive Medicine* **69,** 197-201.

Lloyd M., Temple V. A. & Foley J. T. (2012) International BMI comparison of children and youth with intellectual disabilities participating in Special Olympics. *Research in Developmental Disabilities* **33,** 1708-1714.

Lobstein T., Baur L. & Uauy R. (2004) Obesity in children and young people: A crisis in public health. *Obesity Reviews* **5,** S4-104.

Maiano C. (2011) Prevalence and risk factors of overweight and obesity among children and adolescents with intellectual disabilities. *Obesity Reviews* **12,** 189-97.

Maulik P. K., Mascarenhas M. N., Mathers C. D., Dua T. & Saxena S. (2011) Prevalence of intellectual disability: A meta-analysis of population-based studies. *Research in Developmental Disabilities* **32,** 419-436.

McGillivray J., McVilly K., Skouteris H. & Boganin, C. (2013) Parental Factors Associated With Obesity In Children With Disability: A Systematic Review. *Obesity Reviews* **14,** 541-554.

Popkin B. M. & Gordon-Larsen P. (2004) The nutrition transition: worldwide obesity dynamics and their determinants. *International Journal of Obesity* **28,** S2-S9.

Public Health England (2014) *Obesity and Disability: Children and Young People*. Public Health England, London.

Rutstein S. O. (2008) T*he DHS Wealth Index: Approaches for Rural and Urban Areas. DHS Working Papers No. 60.* Macro International Inc, Calverton, Maryland.

Rutstein S. O. & Johnson K. (2004) *The DHS Wealth Index: DHS Comparative Reports No. 6.* Macro International Inc, Calverton, Maryland.

Salaun L. & Berthouze-Aranda S. E. (2011) Obesity in school children with intellectual disabilitiesc in France. *Journal of Applied Research in Intellectual Disabilities* **24,** 333-40.

Shabayek, M. M. (2003). Assessment of the nutritional status of children with special needs in Alexandria. Part II: Anthropometric measures. *The Journal of the Egyptian Public Health Association, 79*(5-6), 363-382.

Slevin E., Truesdale-Kennedy M., McConkey R., Livingstone B. & Fleming P. (2014) Obesity and overweight in intellectual and non-intellectually disabled children. *Journal of Intellectual Disabilities Research* **58,** 211-20.

Stewart L., Van de Ven L., Katsarou V., Rentziou E., Doran M., Jackson P., Reilly J. J. & Wilson D. (2009) High prevalence of obesity in ambulatory children andadolescents with intellectual disability. *Journal of Intellectual Disabilities Research* **53,** 882-886.

Takeuchi E. (1994) Incidence of obesity among school children with mental retardation in Japan. *American Journal on Mental Retardation* **99,** 283–288.

Tomlinson M., Yasamy M. T., Emerson E., Officer A., Richler D. & Saxena S. (2014) Setting research priorities for intellectual disabilities and autism: A priority setting exercise. *Journal of Intellectual Disability Research* **58,** 1121-30.

UNICEF (2014) *MICS 5: Manual for Anthropometry* http://mics.unicef.org/tools#data-collection. UNICEF, New York.

UNICEF (2015) *Monitoring the Situation of Children and Women for 20 Years: The Multiple Indicator Cluster Surveys (MICS) 1995–2015.* UNICEF, New York.

United Nations Development Programme (2014) *Human Development Report 2014: Sustaining Human Progress: Reducing Vulnerabilities and Building Resilience.* United Nations, New York.

WHO Multicentre Growth Reference Study Group (2006) *WHO Child Growth Standards: Length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: Methods and development.* World Health Organization, Geneva.

World Health Organization (2011) *Rio Political Declaration on Social Determinants of Health* (http://www.who.int/sdhconference/declaration/en/). World Health Organization, Geneva.

World Health Organization (2012) *Population-based approaches to childhood obesity prevention*. World Health Organization, Geneva.

World Health Organization (2015) *Interim Report of the Commission on Ending Childhood Obesity.* World Health Organization, Geneva.

Table 1.

UNICEF's Multiple Cluster Indicators Surveys: Country specific details

Country	MICS Round	Year of Survey	World Bank Income Group	Per Capita GNI	Sampling basis	N (3-4 year old children)	Prevalence of 'Risk of intellectual disability'
Iraq	4	2011	upper middle	14,007	N	13,555	7.9%
Tunisia	4	2012	upper middle	10,440	N	1,137	4.4%
Bhutan	4	2012	lower middle	6,775	N	2,378	4.1%
Swaziland	4	2010	lower middle	5,536	N	1,065	5.1%
Nigeria	4	2011	lower middle	5,353	N	2,378	4.1%
Palestine	4	2010	lower middle	5,168	N	3,895	5.3%
Pakistan (Baluchistan)[a]	4	2010	lower middle	(4,652)	R	4,120	14.4%
Lao PDR	4	2012	lower middle	4,315	N	4,398	5.0%
Ghana	4	2011	lower middle	3,532	N	3,037	7.8%
Mauritania	4	2011	lower middle	2,988	N	3,509	7.3%
Bangladesh	5	2012/13	low	2,713	N	8,593	7.6%
Nepal	4	2014	low	2,194	N	2,224	15.4%
Kenya (Nyanza)	4	2011	low	2,158	R	2,135	11.7%
Sierra Leone	4	2010	low	1,815	N	3,616	20.5%
Chad	4	2010	low	1,622	N	6,734	46.6%
Zimbabwe	5	2014	low	1,307	N	3,857	8.7%
Togo	4	2010	low	1,129	N	1,757	16.4%
Malawi	5	2014/15	low	715	N	7,608	14.8%
Central African Republic	4	2010	low	588	N	3,702	21.4%
Congo	4	2010	low	444	N	3,899	23.6%

Notes

[a] While Pakistan is classed as a lower middle income country, the province of Baluchistan has a significantly lower per capita GDP than the rest of Pakistan.

Per capita Gross National Income (GNI) corrected for 2011 purchasing power parity in US$ taken from 2014 Human Development Report

N = national

R = regional

Table 2:
Estimated prevalence rates for overweight and obesity at ages 3 to 4 among children deemed to be at risk and not at risk of intellectual disability.

Country	Obesity-Wealth Relationship (Spearman's r)[a]	Overweight or Obese				Obese			
		%ID	%Other	Unadjusted OR with 95% Confidence Interval (CI)	Wealth quintile adjusted OR(95%CI)	%ID	%Other	Unadjusted OR with 95% Confidence Interval (CI)	Wealth quintile adjusted OR(95%CI)
UPPER MIDDLE INCOME									
Iraq	+0.05***	7.9%	9.5%	0.82 (0.65-1.04)	0.89 (0.70-1.13)	2.4%	3.1%	0.77 (0.51-1.18)	0.79 (0.51-1.21)
Tunisia	+0.09***	26.0%	21.6%	1.28 (0.67-2.44)	1.32 (0.69-2.52)	15.7%	15.3%	1.03 (0.48-2.34)	1.07 (0.49-2.37)
LOWER MIDDLE INCOME									
Bhutan	+0.04**	11.8%	10.1%	1.19 (0.64-2.21)	1.14 (0.61-2.12)	5.0%	7.3%	0.66 (0.27-1.65)	0.69 (0.29-1.65)
Swaziland	+0.06**	9.4%	11.6%	0.80 (0.31-2.04)	0.85 (0.33-2.15)	0.0%	6.0%	0.14[1] (0.01-2.30)	n/a
Nigeria	-0.02**	6.1%	7.0%	0.86 (0.69-1.08)	0.85 (0.68-1.07)	4.2%	5.1%	0.82 (0.63-1.07)	0.85 (0.65-1.12)
Palestine	+0.04***	7.6%	6.0%	1.30 (0.71-2.39)	1.44 (0.78-2.66)	3.2%	2.6%	1.24 (0.49-3.10)	1.47 (0.59-3.67)
Pakistan (Baluchistan)	-0.09***	25.4%	37.9%	0.56*** (0.42-0.73)	0.55*** (0.42-0.73)	17.4%	27.8%	0.55*** (0.40-0.75)	0.54*** (0.40-0.74)
Lao PDR	+0.05***	3.6%	4.3%	0.84 (0.41-1.74)	1.07 (0.52-2.20)	3.6%	3.5%	1.03 (0.50-2.12)	1.24 (0.58-2.64)
Ghana	+0.04**	2.2%	4.2%	0.50 (0.20-1.24)	0.55 (0.23-1.32)	1.7%	2.9%	0.60 (0.22-1.65)	0.76 (0.30-1.92)
Mauritania	+0.05***	11.1%	8.5%	1.34 (0.89-2.02)	1.40 (0.92-2.12)	8.3%	7.0%	1.20 (0.75-1.91)	1.27 (0.76-1.97)

[1] Estimated by adding 0.5 to each cell (Yates continuity correction).

LOW INCOME									
Bangladesh	+0.01	9.3%	7.4%	1.27 (0.96-1.69)	1.32 (0.99-1.73)	8.5%	6.6%	1.31 (0.98-1.76)	1.31 (0.98-1.76)
Nepal	-0.01	7.0%	5.5%	1.29 (0.81-2.04)	1.22 (0.76-1.95)	5.2%	4.8%	1.09 (0.65-1.84)	1.01 (0.59-1.70)
Kenya (Nyanza)	-0.01	4.3%	3.4%	1.26 (0.64-2.49)	1.10 (0.54-2.24)	1.7%	1.4%	1.26 (0.44-3.66)	1.28 (0.44-3.71)
Chad	-0.04***	14.7%	14.1%	1.05 (0.91-1.20)	1.01 (0.88-1.16)	12.0%	12.3%	0.97 (0.84-1.12)	0.94 (0.81-1.09)
Sierra Leone	+0.02	15.4%	16.2%	0.94 (0.75-1.18)	0.92 (0.73-1.15)	9.8%	10.0%	0.99 (0.75-1.30)	0.96 (0.73-1.27)
Zimbabwe	-0.00	5.4%	5.8%	0.92 (0.56-1.51)	0.95 (0.58-1.58)	4.8%	4.2%	1.13 (0.67-1.92)	1.12 (0.65-1.92)
Togo	-0.00	4.1%	2.6%	1.59 (0.82-3.07)	1.59 (0.80-3.15)	2.1%	1.9%	1.06 (0.44-2.58)	1.12 (0.46-2.71)
Malawi	-0.03***	5.7%	7.2%	0.77 (0.59-1.01)	0.75* (0.57-0.98)	4.2%	4.8%	0.88 (0.65-1.21)	0.84 (0.61-1.15)
Central African Republic	+0.00	4.9%	3.8%	1.29 (0.89-1.88)	1.28 (0.88-1.87)	2.9%	2.2%	1.33 (0.82-2.15)	1.39 (0.86-2.25)
Congo	-0.02*	7.4%	8.0%	0.93 (0.70-1.23)	0.88 (0.66-1.17)	3.9%	5.0%	0.78 (0.53-1.13)	0.74 (0.51-1.08)

Notes

[a] positive correlation indicates obesity more prevalent among wealthier groups

* p<0.05, ** p<0.01, *** p<0.001

ID = Risk of Intellectual Disability, OR = Odds Ratio