

Prevalence of Concurrent Wasting and Stunting among Children 6-59 Months of Age: A Meta-Analysis of Demographic and Health Survey in G5 Sahel Countries

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Abstract: Background: Undernutrition is a major public health among children under five especially in Sahel region. Burkina Faso, Chad, Mali and Niger, are four countries of "G5 Sahel" which is a group of five Sahel countries including Mauritania. The Four countries are landlocked and face challenges of development, demographic, immigration, climate change, food security and terrorism. Wasting and stunting are two forms of undernutrition prevented and/or treated separately. Children presenting concurrently the two forms of malnutrition increased greatly the risk of mortality. The main aim of the present study is to assess the prevalence of children aged 6-59 months concurrently wasted and stunted, and secondly to evaluate prevalence of concurrent wasting and stunting by age group and gender. Methods: Data from Demographic and Health Survey from four countries were analyzed. Pooled prevalence of wasting, stunting, underweight, and concurrent wasting and stunting prevalence among children aged 6-59 months was computed. The pooled prevalence of concurrent wasting and stunting was calculated by age group and gender with 95% confidence interval. Heterogeneity was explored with high inconsistency ($I^2 > 50\%$). Results: A total of 04 surveys met our criteria, with no surveys from Mauritania. Significant heterogeneity was found ($I^2 > 50\%$). The pooled prevalence of stunting was 41.8% (95% CI: 37.8%-46.0%), wasting: 14.0% (95% CI :11.9%-16.4%), and underweight: 30.4% (95% IC: 25.4%-35.6%). The pooled prevalence of children concurrently wasted and stunted was 5.5%, (95% CI: 4.2%, 7.1%) P value = 0.00. Ranging from 4.4%, (95% CI: 3.8%, 5.0%) in Mali to 8.1%, (95% CI :7.%, 8.9%) in Niger. Prevalence of children aged 12-23 months concurrently wasted and stunted was 9.4%, (95% IC: 8.6%, 10.2%). Compared to girls, boys were higher at risk with 6.6%, (95% CI: 6.2%-7.1%) while the prevalence for the girls was 4.4% (95% CI: 4.0, 4.7%). Conclusion: Concurrent wasting and stunting was above 5% in Sahel countries among children aged 6-59 months. Children aged 12-23 months were at higher risk. The children concurrently wasted and stunted have a similar risk of mortality with those who are suffering of severe acute malnutrition, it sound important to give more attention to concurrent wasting and stunting children in designing nutrition program and in current program implementing.

Keywords: Concurrent wasting and stunting, meta-analysis, undernutrition, children 6-59 months, G5 Sahel

1. Introduction

Undernutrition is a public health problem highly prevalent among children under five in under developed countries (Black et al, 2008). It has consequences on cognitive and physical development and contributes to child morbidity and mortality (WHO, 2013). In 2017, 155 million of children under five were stunted and 52 million were wasted (FAO, 2017). It estimated 1.5 million deaths (14.6%) are attributed to wasting and over 1.4 million (14.5%) to stunting per year. Wasting and stunting contribute to the loss of 64.6 and 54.9 million disability adjusted life years, respectively accounting for 14.8% and 12.6% of the total global disability adjusted life among children under five (Black et al 2008).

Wasting (weight-for-height -score $Z < -2$) and stunting (height-for-age -Z-score < -2) are two forms of child undernutrition which continue to be a burden especially in the

developing countries (Richard et al 2012). According to Unicef malnutrition conceptual frame, the causes of undernutrition are multiple but in the most situation comprise limited quality or quantity of food, suboptimal feeding practices, and high rates of infectious diseases (Black et al 2008). Stunting is consequence of a long period of improper feeding practice that may be deteriorated by recurrent infections. Wasting is a result of short-term response to inadequate dietary intake or a recent infectious disease episode and can be reversible if the child has access to adequate dietary intake in an environment that is free from infectious diseases (Saakal and Galaa, 2016).

Children concurrently wasted and stunted have a similar mortality risk to that of severely wasted children. However, the prevalence and burden of this condition is not systematically reported globally. Reducing the prevalence of children under five who are wasted and stunted is a global priority as the consequences are multiples on child growth and

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development (Khara et al 2018). Wasting and stunting are two forms of malnutrition presented separately during the survey and requiring different interventions for prevention and treatment. These two forms of malnutrition are closely linked and happen together in the same in the same targeting group. Wasting and stunting are associated with increased mortality when, child suffer from both. (Brien et al 2015).

The number of children under five who are chronically or acutely undernourished may have decreased in many countries. Global progress to reduce these forms of malnutrition is sufficient to meet world Health Organization Assembly targets by 2025 and achieve Sustainable Development Goal (SDG) target 2.2 to end all forms of malnutrition by 2030 (WHO, 2013) Stunting in Africa was not decrease meaningfully (Onis et al, 2010). A recent DHS meta-analysis conducted in sub-Saharan Africa showed the high prevalence of stunting and wasting especially in Sahel countries (Akombi et al, 2017a).

The estimation of the prevalence and burden of concurrence stunting and wasting among children under five is not systematically reported at national and global levels. (UNICEF, WHO, & World Bank, 2016).

Figures are available separately on the prevalence of wasting and stunting among children under five at country level. The concurrence prevalence of wasting and stunting is rarely reported, and documented. They are also addressed separately.

In this paper we conducted a meta-analysis of data from Demographic and Health Survey from four G5 Sahel countries (Burkina Faso, Niger, Mali and Chad) from (2006- 2016) to evaluate the magnitude of concurrence wasting and stunting among children aged 6 to 59 months.

The study aim was to evaluate the magnitude of concurrent stunting and wasting among children aged 6 to 59 months in four G5 Sahel countries. Secondly, to assess concurrent wasting and stunting by age group and gender.

2. Methods

Data used in this study were obtained from the publicly available DHS website for the four G5 Sahel countries between 2006 and 2016 (DHS, <https://dhsprogram.com/data>). We included data from children aged 6-59 months. The period corresponding of ten years after the introduction of WHO child growth standard in 2006 to identify children those suffering of malnutrition (WHO, 2006).

Standard DHS are generally large with nationally representative. Surveys were conducted every five years and comparable across the countries with a standardized multistage sampling methodology. The survey provides information on a range of health and population indicators including anthropometric information. Multistage sampling was used regularly. Three principal questionnaires were administered in each household: household questionnaire, a

women's questionnaire and a men's questionnaire. Women and men from 15 to 45 years are eligible to participate and also the men in same threshold age. Additional detail on survey methodology is available on DHS site web elsewhere. (DHS, <https://dhsprogram.com/data>). For countries with more than one dataset available between 2006 and 2016, The most recent dataset was chosen. Data were downloaded on SPSS Version 23.0 for analysis.

Anthropometric indicators

Stunting among children 6-59 months age was defined as those with height-for-age, z-score (HAZ) < -2, and wasting was defined as those with weight-for-height or length, z-score (WHZ) < -2 and children concurrently wasted and stunted defined as HAZ < -2 and WHZ < -2, respectively. The z-scores were computed using the WHO 2016 growth reference standards using the SPSS version 23 (IBM SPSS version 23 & WHO 2006). Five age groups were defined: 6 to 11 months, 12 to 23 months, 24 to 35 months, 36 to 47 months and 48 to 59 months

Statistical analysis

The meta-analysis of pooled prevalence data was performed using MetaXL version 5.3 software. A double arcsine transformation was used to generate the pooled prevalence (Barendregt et al, 2013). Pooled prevalence is associated with 95% Confident Intervals (CI). A random effect model was used in the meta-analysis.

Heterogeneity of accuracy measures was explored with the I^2 estimate (inconsistency measure) from Cochran Q according to the formula: $I^2 = 100 \times (\text{Cochran Q} - \text{degree of freedom}) / \text{Cochran Q}$. It describes the percentage of the variability in effect that is due to heterogeneity rather than sampling error (Nikolas et al, 2008). The heterogeneity obtained in different countries showed a high level of inconsistency ($I^2 > 50\%$). The sensitivity test was conducted by moving one study and comparing the pooled prevalence before and after removing one of the country (Epigear international 2016).

Inclusion criteria

Only countries with a DHS survey conducted between 2006 and 2016 with anthropometric indicators for children under 5 months were included.

Ethical Considerations

Approval access to datasets was obtained after online registration on the DHS program website (DHS, <https://dhsprogram.com/data>). Ethical approval was obtained from Niger national ethical committee number O47/2018/CNERS..

3. Results

A total of four countries of G5 Sahel had dataset eligible for analysis. Dataset from Mauritania was not eligible. Globally, 25382 children aged between 6 -59 months were included into

the analysis after selected the most recent dataset available for each country.

Prevalence of wasting, stunting and underweight: The pooled prevalence of malnutrition among children aged 6-59 months was 41.8% (95% CI: 38.8%,46.0%) for stunting, 14.0% (95% CI:11.9%, 16.4%) for wasting and 30.4% (95% CI:25.4%, 35.6%) for underweight.(Table1)

Prevalence concurrent wasting and stunting: The pooled prevalence of children concurrently wasted and stunted was 5.5%,(95% CI 4.1%, 7.0%)and P=0.00). The prevalence of concurrent wasting and stunting across the country varied from 4.4% (95% CI: 3.8%, 5.0%) in Mali to 8.1% (95% CI: 7.4%, 8.9% in Niger, $I^2=95.9%$ and P value: =0.00.(Table2)

Prevalence concurrent wasting and stunting by age group and gender: The prevalence of children concurrently wasted and stunted by agegroup showed a significantly high prevalence in the 12 to 23 months age group.9.4% (95% CI: 8.6%, 10.2%) and P value P:0.00 . (Table3). The prevalence of children concurrently wasted and stunted across the country was also high in 12 to 23 months. It varied from 8.0% (95% CI: 6.%, 9.9%) with P value =0.00 in Mali to 14.3% (95% CI: 12.1%, 16.5%) in Niger with P value = 0.00 . (Table 4).Gender difference was observed with a high concurrent stunting and wasting prevalence among the male: 6.6%, (95% CI: 6.2%, 7.2%) versus 4.4% (95%CI: 4.0%, 4.7%) for the female with P value P=0.00. Table5.Separately analyzed, stunting and wasting are higher among male comparatively to female. The pooled prevalence of wasting by gender showed that the male are higher at risk than the female with respectively 17.9% (95%CI: 14.3%-15.5%) and 12.3% (95% CI: 12.0%-13.2%). The Pooled prevalence of stunting by gender showed also that the male are most at risk than the female 43.7 % (95% CI:42.5%-44.2%) versus 40.0%(95% CI:39.1%-40.9%).

4. Discussion

The main goal of our study is to assess the magnitude of concurrent wasting and stunting among children from 6- 59 months belonging four countries of G5 Sahel, secondly to determine the prevalence of concurrent wasting and stunting by age group and gender to figure out those who are at higher risk.

The study revealed that among children aged 6-59 months concurrently wasted and stunted the prevalence was 5.5%, (95% CI 4.1%, 7.0%) P=0.00). The pooled prevalence of concurrent wasting and stunting varies between countries. Two countries had prevalence rates over 5%, Niger and Chad with respectively 8.1%(95% CI: 7.4%, 8.9% and 5.4% (95%CI: 4.9-5.8) while Burkina Faso had 4.7% (95% CI: 4.2%, 5.3%) and Mali 4.4% (95% CI: 3.8%, 5.0%). A country prevalence >5% of severe wasting among children under five would justify emergency intervention with intensification of screening and treatment to save those who are severely malnourished.Khara et al in a meta-analysis found 9 countries

over 84 had a concurrence prevalence of wasting and stunting greater than 5%. Six werefrom sub-Saharan Africa and two from Sahel region(Khara et al, 2018).

Children concurrently wasted and stunted are 12 times more at risk to die than children who are never experienced wasted nor stunted. The risk of mortality is similar to that estimated for severe wasting(Olinfin et al, 2013).

As the concurrence of wasting and stunting is associated with similar mortality risks to severe wasting strong actions must be taken for that. First, cases must be systematically notified to health information system and secondly its prevalence should be monitored (Khara et al, 2018).Wasting and stunting are both related in growing mortality, particularly when the same children are concurrently wasted and stunted(Brien et al, 2015 & Mcdonald et al 2013).

The occurrence of low muscle mass during the two forms of malnutrition and, the relationship between muscle mass and survival indicate that wasting and stunting could increase the risk of death. The severe form of the two condition are strongly associated with mortality risk. The mortality associated with severe stunting is higher than that associated with moderate wasting. The high decrease in muscle mass during wasting could explain the higher risk of death of wasted children compared to those suffering from stunting (Olinfin et al, 2013). Body fat plays a keyrole in regulating bone mass and linear growth (Dewey et al 2005). The fact that wasting is a reflection of depletion in fat and muscle, implies that a wasted child may suffer from stunting. Studies showed that the fat tissues produce leptin which influence bone density, catch growth and immunity system. Furthermore, growth in height occurs only when the body has a minimum of energy reserves(Brien et al 2015 & Karsenty 2006). Walker et al study showed that among children with Severe Acute Malnutrition (SAM) two-thirds of them started grow after getting a weight-for-height of 85% of the NCHS Median(walker & Golden 1988). Doherty et al study revealed that during severe acute malnutrition treatment, weight for-height increased with linear growth accelerated. There is no clear threshold above which growth resumed. (Doherty et al 2001).

In a recent Meta-analysis reported in Demographic Health Survey (DHS) from 84 countries, 3.0% of concurrent wasting and stunting was found among children 6-59 months aged (Khara et al, 2018).Saaka and Gaala in 2014 DHS data from Ghana analysis, reported a lower concurrent prevalence of 1.4% among children 0-59 months.This prevalence of concurrent wasting and stunting are lower than our study findings.

The results of our study showed that there were age group difference in pooled prevalence of concurrent wasting and stunting among children 6-59 months aged. . The association was the strongest among children aged 12–23 months and 24-35months respectively 9.4% (95% CI:8.6-10.2%) and 6.6% (95% CI:6.0-7.3%). Concurrent wasting and stunting among

children aged 12-23 months was very high in Sahel region. However, it masks disparities between the countries. It varied from 8.0% (95% CI: 6.4%, 9.9%) in Mali to 14.3% (95% CI: 12.1%, 16.5%) in Niger. As children concurrently wasted and stunted present similar risk of mortality to those who are suffering of severe wasting, it is strongly recommended to report systematically the prevalence of concurrent wasting and stunting among children under five during the survey particularly in Sahel region. Some studies showed that stunting and wasting were positively associated among children 12-23 months in Asian and Eastern Mediterranean countries (*Victoria, 1992 & Frangillo, 1997*). The high prevalence of children concurrently wasted and stunted in G5 Sahel countries is a good reason that intervention should target as priority children who have high risk of mortality and those who could responding to treatment.

Khara et al found during a meta-analysis that the younger children (12-36) months aged had a strong risk of concurrence wasting and stunting. However, our finding was higher than what reported by Khara et al (*Khara et al, 2018*).

We found that male are significantly at higher risk to concurrent wasting and stunting than the female with respectively 6.6% (95% CI: 6.2%, 7.1%) and 4.4% (95% CI: 4.0%, 4.7%) with P value=0.00. This results are consistent with findings from several studies which reported that the boys are likely nutritionally more vulnerable than the girls in the nutrition (*Shashank & Mahabaleshwar 2015, Khara et al, Akombi et al, 2017 b, Lesiapeto et al, 2010, Gutu and harma, 2014*), but it is rarely considered when designing a nutrition program. Nutrition Policies makers and Nutrition programs designers must take account inequities in designing and implementing nutrition programs as recommended in the Scaling up Nutrition Movement Strategy 2012-2015 in respect especially of women, girls and boys right (*Scaling up Nutrition, 2012*).

The immediate underlying and basic causes of malnutrition sound to be common to both wasting and stunting (*Khara et al, 2018*). Stunting and Wasting occur through a common mechanism. Any intervention designed to have an impact on stunting should also have an effect on the mortality risk associated with the wasting vice versa (*Brien et al 2015*). Thus, It's important to design and implement simultaneously prevent both forms of malnutrition and treat wasting including prevention in Sahel region as both wasting and stunting are highly prevalent in G5 Sahel countries. Wasting and stunting are interrelated selecting interventions must be based on the two criteria. There is no justification for different interventions for these two forms of malnutrition, except in situation where stunting is present in the absence of wasting (*Brien et al 2015*).

The strength of the study it is nationally representative of each country included and provided concurrent wasting and stunting prevalence, which is not previously reported during the survey in Sahel countries. The high prevalence of concurrent wasting and stunting among children aged 6-59

month could be a leitmotiv for the program managers and policies makersto take account the prevalence of concurrent wasting and stunting in the Sahel countries.

The study limitation is to give concurrent wasting and stunting from 2006 to 2016. It's not a current nutritional status of children.

5. Conclusion

Our study showed a high prevalence of concurrent wasting and stunting in Sahel countries and it varied from country to another. Children aged 12-23 months were at higher risk of concurrent wasting and stunting followed by 24 -35 months aged. It is necessary in countries with high prevalence of concurrent wasting and stunting to design and implement programs focus on those who are at high risk of mortality including children who are wasted and stunted concurrently.

6. Sources of support

The study did not received any found.

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8. Conflict of interests

All authors declare that they have no conflict of interests.

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Tables

Table1 : Pooled prevalence of undernutrition in four countries of Sahel

Undernutrition	Total (N)	N of cases undernutrition	Pooled prevalence rate	CI 95%	
				LCI	HCI
stunting	25377	10644	41.8%	37.8%	46.0%
Wasting	25382	3522	14.0%	11.9%	16.4%
Underweight	25358	7707	30.4%	25.9%	35.6%

Table 2: Pooled prevalence of concurrent wasting and stunting among children aged 6-59 months

Study	Total (N)	n of cases concurrent wasted and Stunted	n/N prevalence rate	95%		P Value
				LCI	HCI	
Niger2012	4854	395	8.1%	7.4%	8.9%	0.00
Burkina Faso 2010	6256	296	4.7%	4.2%	5.3%	0.00
Mali 2012-2013	4536	199	4.4%	3.8%	5.0%	0.00
Tchad 2014-2015	9736	523	5.4%	4.9%	5.8%	0.00
Pooled	28382	1413	5.5%	4.2%	7.1%	0.00

Table 3: pooled prevalence of concurrent wasting and stunting by age group

Age group	Total (N)	n of cases concurrence wasted and stunted	n/Nprevalence rate	IC 95%		P Value
				LCI	HCI	
6-11	2884	130	4.5%	3.7%	5.2%	0.00
12-23	5169	488	9.4%	8.6%	10.2%	
24-35	5567	370	6.6%	6.0%	7.3%	
36-47	5946	248	4.1%	3.6%	4.6%	
48-59	5809	177	3.0%	2.6%	3.5%	

Table 4: Prevalence of concurrent wasting and stunting by age group desegregate by country

Study name	Age group	Total (N)	n of cases concurrently wasted and stunted	n/N prevalence rate	IC 95%		P Value
					LCI	HCI	
Niger 2012	6-11	534	36	6.7%	4.7%	9.0%	0,00
	12-23	958	137	14.3%	12.1%	16.5%	
	24-35	1124	115	10.2%	8.5%	12.0%	
	36-47	1170	62	5.2%	4.0%	6.6%	
	48-59	1070	45	4.2%	3.0%	5.4%	
	pooled	4856	395	8.1%	7.4%	8.9%	
Burkina Faso 2010	6-11	718	34	4.7%	3.2%	6.4%	0,00
	12-23	1364	114	8.3%	6.9%	9.8%	
	24-35	1384	79	5.7%	4.5%	6.9%	
	36-47	1400	41	2.9%	1.3%	2.8%	
	48-59	1390	28	2.0%	1.2%	2.8%	
	pooled	6256	296	4.7%	4.2%	5.3%	
Mali 2012-2013	6-11	498	22	4.4%	2.7%	6.4%	0,00
	12-23	940	76	8.0%	6.4%	9.9%	
	24-35	981	39	3.8%	2.8%	5.2%	
	36-47	1098	39	3.5%	2.5%	4.7%	
	48-59	1019	23	2.2%	1.4%	3.2%	
	pooled	4536	199	4.4%	3.8%	5.0%	
Chad 2014-2015	6-11	1134	38	3.3%	2.3%	4.4%	0,00
	12-23	1907	161	8.4%	7.2%	9.7%	
	24-35	2078	137	6.5%	5.5%	7.7%	
	36-47	2278	106	4.6%	3.8%	5.5%	
	48-59	2330	81	3.4%	2.7%	4.2%	
	pooled	9727	523	5.4%	4.9%	5.8%	

Table 5: Pooled Prevalence of concurrent wasting and stunting by gender among children aged 6-59 months

Gender	Total (N)	n of cases concurrence wasted and stunted	n/Nprevalence rate	IC 95%		P Value
				LCI	HCI	
Male	12788	855	6.6%	6.2%	7.1%	0.00
female	12587	556	4.4%	4.0%	4.7%	0.00