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**Research/Technical Note**

# Impact of Malnutrition and Measles Mortality on Underfives All-Cause Mortality in Gweru City, Zimbabwe, in 1960-89

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**Abstract:** A study was carried out to determine secular changes in all-cause mortality rates for children aged < 5 years in 1960-1989 and their association with measles and malnutrition mortality rates in the same age group in the same period in city of Gweru, Zimbabwe. The study utilized under-fives mortality data from births and deaths registration office and measles and malnutrition surveillance data obtained from Gweru city's public health department. Data was analysed in SPSS version 20 for windows and linear regression analysis was used to determine whether measles and malnutrition mortality rates were independent predictors of all-cause underfives mortality rates. It was found that in 1960-1989 underfives mortality rates from all causes were 10.2-63.7/1000 live births (median: 28.7,  $Q_1 = 16.2$ ,  $Q_3 = 42.6$ ) and these rates significantly and linearly declined in this period ( $\chi^2$  for linear trend=165.74,  $p < 0.001$ ). Measles mortality rates among underfives significantly and linearly declined ( $\chi^2$  for linear trend = 812.49,  $p < 0.001$ ) while malnutrition mortality rates in the same age group also significantly and linearly declined ( $X^2$  for linear trend = 2411.54,  $p < 0.001$ ) in underfives in 1960-1989. Linear regression analysis indicated that malnutrition mortality rates (Regression Coefficient = 0.072, 95% CI = 0.039 - 0.104,  $p < 0.001$ ) and measles mortality rates (Regression Coefficient = 0.029, 95% CI = 0.006-0.052,  $p=0.02$ ) were independent predictors of all-cause underfives mortality rates with an adjusted coefficient of determination of 70.5% (Adjusted  $R^2 = 0.7048$ ) with malnutrition mortality rates uniquely explaining 21% of the variance in all-cause mortality (semipartial correlation squared = 0.21) while measles mortality rates uniquely explained 7% of the variance in all-cause mortality rates (semipartial correlation squared = 0.068). It was concluded that decline in malnutrition and measles mortality rates among underfives significantly contributed to decline in all-cause underfives mortality rates in 1960-89 in Gweru city, Zimbabwe. On account of these findings, it is critical that efforts directed at controlling malnutrition and measles be intensified in areas and populations of similar settings.

**Keywords:** Underfives All-Cause Mortality, Measles, Malnutrition, Gweru, Zimbabwe

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## 1. Introduction

Malnutrition and measles are known to contribute significantly to all-cause underfives mortality and, consequently, their control would contribute substantially to reduction in all-cause underfives mortality [1-3]. Underfives mortality attributed to undernutrition has been estimated at 53-55% [2, 4] and on account of this it has been concluded that effort directed at reducing malnutrition should be a policy priority [1]. Measles was estimated to cause 7% [5] and 1% [6] of underfives mortality in 1990

and 2008 respectively. Measles control through improved vaccination efforts is estimated to have reduced all-cause child mortality by 23% in the period 1990-2008 [3]. On account of the importance of malnutrition and measles to child deaths, a retrospective study that examined secular changes in all-cause underfives mortality in the period 1960-89 in the city of Gweru in Zimbabwe also explored the relationship between these secular changes and mortality attributed to measles and malnutrition in children of the same age group in the same period. This paper reports on this study.

## 2. Materials and Methods

### 2.1. Study Design

Data on measles and malnutrition mortality, and mortality from all causes among underfives for the period 1960-1989 were reviewed. Secular trends in measles and malnutrition mortality rates, and rates of mortality from all causes among underfives were quantified. Association between all-cause underfives mortality rates, and measles and malnutrition mortality rates in the same age group were explored.

### 2.2. Sources of Data

(a) Data on deaths among underfives were obtained from the office of the registrar of births and deaths in Gweru.

(b) Data on measles mortality among underfives was obtained from city of Gweru measles surveillance records. In Gweru measles cases are identified through a surveillance system that records cases and deaths that are reported from the city's health centres, community and the city's infectious disease hospital. Data on measles cases and deaths are entered on line lists that indicate date of identification of a case, age at infection, gender, vaccination status, presenting features, whether admitted into hospital or not, treatment and outcome of illness (alive or dead).

(c) Data on malnutrition mortality among underfives was obtained from Gweru city's nutrition surveillance system. In Gweru city public health department data on nutrition-associated mortality in underfives is collected as one of the items of the nutritional surveillance system. The data indicates date of death, age at death, gender and type of nutritional deficiency responsible for death.

### 2.3. Data Analysis

The following were determined for each year in the period 1960-89:

(a) All-cause mortality rates for underfives per 1000 live births.

(b) Measles mortality rates per 100 000 population of underfives.

(c) Malnutrition mortality rates per 100 000 population of underfives.

The data were entered into and analysed in SPSS version 20.0 for Windows. The Forward Stepwise Multiple Linear Regression method was used to determine whether measles and malnutrition mortality rates were independent predictors of all-cause mortality rates for underfives. The probability of the F test for the variable to enter the model was set at 5% and to remove was 6%.

### 2.4. Main Outcome Measures

Mortality rates from all causes for underfives.

## 3. Results

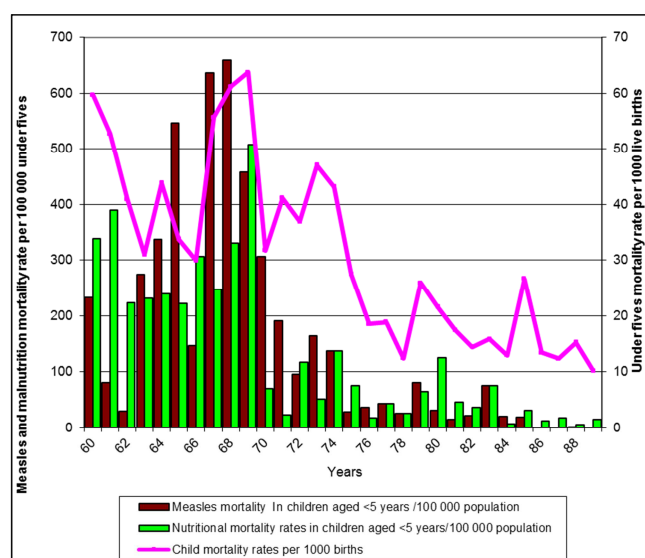
Measles and malnutrition mortality rates among underfives, and all-cause mortality rates for the same age group in the period 1960-1989 are indicated in table 1 and figure 1.

In 1960-89 the all-cause mortality rates for underfives were 10.2-63.7 per 1000 live births (median: 28.7,  $Q_1=16.2$ ,  $Q_3=42.6$ ). These rates significantly and linearly declined in this period ( $\chi^2$  for linear trend= 165.74,  $p<0.001$ ).

**Table 1.** Measles and malnutrition mortality rates among underfives, and all-cause underfives mortality rates in Gweru city, Zimbabwe, 1960-1989.

Year	All-cause underfives mortality rates /1000 live births	Measles mortality rates among underfives /100 000 population of underfives	Malnutrition mortality rates among underfives/100 000 population of underfives
1960	59.7	231.9	338.9
61	52.7	81.05	389
62	40.9	29.27	222.8
63	31.0	274.3	231
64	43.8	337.2	238.8
65	33.7	546.1	221.9
66	29.9	146.6	306.5
67	55.7	636.7	246.9
68	61.2	659.2	329.6
69	63.7	457.9	507.4
1970	31.7	305.5	70.5
71	41.1	190.1	22.4
72	36.9	96	117.3
73	47.0	163.2	50.9
74	43.1	136.8	136.8
75	27.4	28.1	74.9
76	18.5	36	18
77	18.8	43.4	43.4
78	12.4	25.1	25.1
79	25.9	80.7	64.6
1980	21.5	31.2	124.8
81	17.4	15.1	45.3
82	14.4	21.9	36.5
83	15.8	75.9	75.9
84	12.9	19.6	6.5
85	26.6	18.6	30.9

Year	All-cause underfives mortality rates /1000 live births	Measles mortality rates among underfives /100 000 population of underfives	Malnutrition mortality rates among underfives/100 000 population of underfives
86	13.4	0	11.8
87	12.3	0	16.9
88	15.2	1	5.4
1989	10.2	0	15.5
Range			
Minimum	10.2	0	5.4
Maximum	63.7	659.2	507.4
Percentiles			
Q <sub>1</sub>	16.2	22.7	25.6
Median	28.7	78.3	72.7
Q <sub>3</sub>	42.6	221.45	228.9
Mean	31.2	156.3	134.2



**Figure 1.** Measles and malnutrition mortality rates among underfives, and all-cause underfives mortality rates in Gweru city, Zimbabwe, 1960-1989.

In 1960-1989 measles mortality rates among underfives were 0 - 659.2 per 100 000 population (median: 78.3, Q<sub>1</sub> = 22.7, Q<sub>3</sub> = 221.5). These rates significantly and linearly declined in this period ( $\chi^2$  for linear trend = 812.49,  $p < 0.001$ ).

Malnutrition mortality rates among underfives in 1960-1989 were 5.4 – 507.4 per 100 000 population (median: 72.7, Q<sub>1</sub> = 26.6, Q<sub>3</sub> = 228.9). In this period these rates significantly and linearly declined ( $\chi^2$  for linear trend = 2411.54,  $p < 0.001$ ).

#### Linear regression analysis.

Results indicated that malnutrition mortality rates among underfives (Regression Coefficient = 0.072, 95% CI = 0.039 - 0.104,  $p < 0.001$ ) and measles mortality rates in the same age group (Regression Coefficient = 0.029, 95% CI = 0.006-0.052,  $p = 0.02$ ) were independent predictors of all-cause underfives mortality rates with an adjusted coefficient of determination of 70.5% (Adjusted  $R^2$  = 0.7048) with malnutrition mortality rates uniquely explaining 21% of the variance in all-cause mortality (semipartial correlation squared = 0.21) while measles mortality rates uniquely explained 7% of the variance in all-cause mortality (semipartial correlation squared = 0.068).

## 4. Discussion

This study found that all-cause mortality rates for underfives declined over the 30 year period 1960-89 and that this decline was associated with decline in malnutrition and measles mortality rates in this age group in the same period.

Studies that have investigated secular trends of underfives mortality in developing countries have found that these mortality rates declined in the period 1960-89 [7-10] and thus findings of the current study concur with these studies. In Zimbabwe, like in the current study, underfives mortality declined in 1960-1990 [7, 8] but increased in the 1990s due to worsening economic conditions and the direct and indirect impact of the HIV/AIDS epidemic [8, 11].

In this study it was found that measles and malnutrition mortality rates among underfives declined in 1960-89. A study that examined secular trends in mortality attributed to measles in Gweru in 1967-89 found that both measles and malnutrition mortality rates had declined among underfives in that period [12]. From findings of the current study it would seem that decline in measles and malnutrition mortality rates observed in that study [12] are likely to have been a continuation of a trend that would have commenced in 1960 or before.

The current study found that in 1960-89 decline in malnutrition and measles mortality rates among underfives accounted for 70.5% of variation in all-cause underfives mortality rates. The implication of this finding is that in Gweru in this period malnutrition and measles may have been the conditions mostly associated with mortality among underfives – probably meaning that oft mentioned factors such as neonatal disorders, pneumonia, diarrhoea and malaria that are said to be major causes of mortality among underfives [8, 10, 13, 14] or factors such as socio-economic conditions that are known to have strong impact on underfives mortality in developing countries [15] would all seem to have contributed only 29.5% of the variation in all-cause underfives mortality. In 2000-03 major causes of underfives mortality in developing countries were said to be neonatal disorders, pneumonia and diarrhoea which were estimated to account for 73% of all underfives mortality while malaria, measles, HIV/AIDS, injuries and other causes accounted for the remaining 27% [14]. Differences between

major causes of mortality in Gweru in 1960-89 (as found in the current study) and estimates of major causes of underfives mortality indicated for 2000-03 for developing countries [14] seem to demonstrate that major causes of underfives mortality are period specific (as in time or era) [1] and area specific (as in geographical distribution) [13, 14].

The current study found that malnutrition mortality rates among underfives uniquely explained 21% of the variance in all-cause underfives mortality while measles mortality rates uniquely explained only 7% of the variance in all-cause mortality of the same age group. Malnutrition is an underlying cause of half of all deaths occurring among underfives in developing countries [13, 14, 16]. Also, among underfives malnutrition is strongly associated with increased risk of mortality from diarrhoea, acute lower respiratory infections and pneumonia, malaria, and measles [13, 17]. Studies indicated earlier [13, 14] have found that measles (compared to conditions such as pneumonia, diarrhoea etc.) is associated with a small proportion of deaths among underfives in developing countries. The implication of this finding is, as found in the current study, that the effect of malnutrition mortality rates on all-cause underfives mortality rates would be much bigger compared to that of measles mortality rates on account of the fact that malnutrition is associated with a far greater proportion of underfives mortality compared to measles.

## 5. Limitations of the Study

A major limitation of the current study was that variables that were examined were few. This is due to the fact that in 1960-89 data relating to management and outcomes of factors associated with underfives mortality such as neonatal disorders, pneumonia, diarrhoea, malaria etc. were for most part incomplete or inadequate. Equally, data that would have enabled measurement of impact of socio-economic conditions on underfives mortality were not available. In the absence of adequate data on these variables it was not possible to examine how they specifically contributed to decline in underfives mortality in 1960-89.

## 6. Conclusion

Decline in malnutrition and measles mortality rates among underfives significantly contributed to decline in all-cause underfives mortality rates in 1960-89 in Gweru city, Zimbabwe. On account of these findings, it is critical that efforts directed at controlling malnutrition and measles be intensified in areas and populations of similar settings.

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