Contextual determinants of adolescent mortality in South Africa.

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Abstract:

Objectives: South Africa has a large adolescent population (approximately 20% of the total population). The survival and development of these individuals are a priority among parents and the government. In an effort to better understand the factors contributing to adolescent mortality in South Africa, this study examined the effect of household and community factors on adolescent death.

Methods: The study used data from Census 2001. Multilevel modelling was used to study the impact of community and household factors on adolescent mortality. A multivariate binary logistic 2- level model was developed. Odds ratios were produced and, statistically significant values ($p<0.05$) were discussed. There were 41,261 reported adolescent deaths from census data.

Results: This study found that having a few household assets, six or more people living in a residence, and high racial diversity is associated with increased odds of adolescent mortality in South Africa in 2001.

Conclusions: Socio-economic status of the household and racial diversity within communities is likely to increase adolescent mortality in South Africa. However, there is need to examine the role of other community characteristics, such as number of schools, health facilities and employment opportunities in order to create a holistic profile of the contextual determinants of adolescent mortality in the country.

Keywords: Adolescent mortality, South Africa.

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Introduction

Adolescence is an age of transition from childhood into adulthood. Adolescents, who are between the ages of 10 and 19 years old, embody the potential social and economic development of a country, since these individuals will be future parents, caregivers and employers. However during adolescence, these persons are at varying lengths of social and economic dependence and independence. During this transitional period, they are also highly vulnerable to household and community influences that impact their development and survival.

Little research has been done on adolescent mortality in South Africa. Research which incorporates adolescents into child and adult age groups has been done, but this fails to highlight the plight of this transitional period[1,2]. In addition, the limited research on this age group could be because adolescents have lower reported rates of mortality compared to children under-five years and adults[3]. Research on individual-level factors such as race and provincial distributions of adolescent death in the 1980s are noted[4]. However, individuals exist within households and households exist within communities and neighbourhoods. Ecological studies of health and development have argued that these outcomes are influenced by more than just agency and individual characteristics[5-7]. These studies have found that the health and development outcomes of individuals are affected by the households and communities to which people belong. Research on infant, child and adult mortality for example, has found that household and community characteristics are an important determinant of their survival[8,9]. Thus, individual characteristics, demographic and socio-economic factors alone are no longer sufficient in research attempting to establish associations and determinants of mortality. There is need for a different approach to understanding the mortality outcomes of adolescents. Since individuals are informally referred to as 'products of their environments' it is these environments that need to be studied in establishing possible determinants of mortality.

Research has recognised the need to consider community and environmental characteristics in health studies. In this

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study multilevel modelling was used to avoid the problem of ecological fallacy which occurs when inferences are made about individuals from group data[10]. Alternatively, relying on individual level analysis for the study of adolescent mortality would result in a misunderstanding of the effect of household and community influences on mortality outcomes. Individual level analysis will ignore the exogenous influences of households and neighbourhoods on mortality outcomes.

For this reason multilevel models have also appealed to many different disciplines of study, including social sciences, because of this practice of examining hierarchical social structures[11]. Since in social sciences, social structures are hierarchical in nature, multilevel models are used. This study produced findings which may direct policy toward addressing household and community issues in their relation to adolescent mortality, as opposed to policy which focuses merely on the individual. In this way , policy will be able to address the needs of individuals as grouped by their type of community and household and hopefully target a larger number of adolescents.

This study aimed to identify the household and community factors associated with adolescent mortality in South Africa. In order for the country to develop its relatively large adolescent population, the first step is to ensure the health and survival of this population. This study will contribute to the dearth of existing literature on adolescent mortality and can be used to inform the National Youth Development Policy, which aims to ensure the successful and healthy transition of children into adults.

Methods

This study used data from the South African National Census of 2001. During October 2001 the Census in South Africa took place. People living in households across the country, as well as those in hostels, hotels, hospitals and all other types of communal living quarters, and even the homeless, were all visited. In preparation for the count, the entire country had been divided into approximately 80,000 enumeration areas (EAs), each containing an average of 150 households[12].

Using the Census data from 2001, household respondents who reported that a member of the household between the ages of 10 and 19 years old, had died a response of 'yes' was classified as an adolescent death. The data contained only information regarding the age and sex of the deceased adolescents, as reported by their household members. Because of this, no other individual characteristics of the deceased could be controlled for in the study. In total 41,261 adolescent deaths were recorded in the dataset. The sample consists of approximately 30 households within each cluster. All private households, within which an adolescent had died were selected and used from each cluster.

Predictor variables and variable definitions

Household level variables were reported by household heads in the surveys. The variables used here were household assets, income, number of people living in the residence, tenure ownership and province. Household income was selected as a direct measure of a household's socioeconomic status. In this study, income was segregated into; low income households ≤R38, 400 per annum, average income households R38, 401 – R153, 600 per annum and high income households ≥ R153, 601 per annum.

The community variables represent individual responses which were aggregated by District. Responses from the household surveys pertaining to race and income, were aggregated and proportions for specific geographical locations were attained for the purpose of multilevel analysis. Community racial diversity was the proportion of Black, White, Coloured and Indian/Asian households in the community. This variable measured racial or population group diversity within communities. If the households in the community were predominantly a single race or population group, then the racial diversity was considered low. If the community households were made up various combinations of the four racial groups, the racial diversity was considered high.

Community poverty was measured as the proportion of households with the lowest reported annual income <R38, 400 per annum. This measure was also divided into three quintiles and categorised as low, medium and high. If there were many households in the community with an annual income of less than R38, 400 per annum, then it was considered a high poverty area. Conversely, if the community had a majority of households that earned an annual income of more than R38, 400 per annum, then community poverty was considered low.

In order to meet the objective of this study, to determine the relationship between household and community char-

acteristics and adolescent health outcomes at different levels, multilevel analysis was done. The outcome variable all causes of death in this study were binary, there were 'yes' or 'no' responses. For this reason a two- level model for dichotomous or binary outcomes was used.

These two levels, the first being a standard logistic regression model and the second accounting for additional, related characteristics, were combined to create the two-level model. The equation for a two- level model for a dichotomous outcome was as follows:

$\log[pij/1-pij] = \beta 0+\beta 1xij +uj$ Combined model

Where uj is the random effect at level two, without uj, would be a standard logistic regression model. Conditional on uj, yijs were assumed to be independent[11]. Odds ratios were produced and expressed at a 95% confidence interval.

The community differences in adolescent mortality may be due to contextual influences or differences in individual composition of communities including unobserved individual characteristics[13]. Thus it is suggested by Merlo and others[13] that "while adjusting for the individual characteristics in the multilevel models, some part of the compositional differences were taken into consideration to explain some of the community differences observed in the empty model. The equation for the proportional change in community variance was:

PCV1 = VN-1 – VN-2/ VN-1

Where:

VN-1 is the community variance in the empty model and VN-2 is the community variance in the models including household characteristics or community characteristics"[13]

This multilevel modelling technique was required for this study to remove the effect of clustering, to study the effect of variables acting at different levels and to examine the variation of the effect across the levels. Due to the hierarchical nature of the data that was used, the effect of clustering needed to be removed in order to obtain valid point estimates for the study parameters and standard errors for the point estimates[9]. In addition, it was a focus of this study to examine determinants of mortality outcomes. For this reason, there was need to examine the effect of each explanatory variable and inspect the extent of the variation across the different levels[9].

To show the variation clearly, four models were produced with different combinations of the individual/ household and community variables as follows:

Model I - was the empty or null model.

Model II - considered each of the explanatory variables at the household – level and the outcome of the risk of adolescent mortality.

Model III –considered each of the explanatory variables at the community – level and the outcome of the risk of adolescent mortality.

Model IV –considered the household and community – level variables and the outcome of the risk of adolescent mortality.

Results

Table 1 shows the percentage distribution of adolescent deaths by household and community characteristics. For all-cause mortality, 55.51% of adolescent deaths occurred in households with low assets. Further, 64.17% of adolescent deaths occurred in low income and 61.06% adolescent deaths were in households that had less than 5 residents. By province of residence, 15.22% of adolescent deaths occurred in the Eastern Cape and 13.94% deaths were in the KwaZulu Natal province. By community, 75.45% of adolescent deaths happened in urban dwellings, 64.17% of adolescent deaths were in communities with a low level of poverty and finally 79.25% of deaths were in low racial diversity communities.

Table 1: Percentage distribution of adolescent deaths by household and community characteristics, South Africa, 2001

Characteristics	P-value	Adolescent death (%)
Household Variables		
Assets		
Low		55.51
Middle	0.001	32.23
High		12.26
Income		
Low		64.17
Average	0.001	32.38
High		3.45
Number of people living in residence		
Less than or 5		61.06
More than or 6	0.001	38.94
Tenure		
Own		70.43
Rent	0.001	14.17
Occupy, rent-free		15.4
Province of Residence		
Eastern Cape		15.22
Free State		12.52
Gauteng		8.88
KwaZulu Natal		13.94
Mpumalanga	0.001	14.24
North West		12.03
Northern Cape		8.66
Limpopo		5.66
Western Cape		8.85
Community Variables		
Type of place of residence		
Urban		75.45
Rural	0.001	24.55
Poverty		
Low		64.71
Medium		32.38
High	0.001	3.45
Racial Diversity		
Low		79.25
Medium	0.001	7.5
High		13.25

Results in Table 2 Model I showed significant variation in the likelihood of occurrences of adolescent mortality across communities $\tau = 10.921$, $p = 0.001$. As shown by the variance partition coefficient, the intra-community correlation coefficient was estimated at 70%.

Model II shows the results of the effects of household level variables. Household assets are significantly associated with adolescent mortality. The table shows that adolescent mortality is more likely to occur in households with an average or middle number of assets compared to households with low or no assets. Households where income is high have lesser odds of experiencing adolescent mortality than poor households. In addition, if there are more than or 6 people living in a single residence the odds of adolescent mortality increase to 1.17 times more than residences with fewer than or 5 people. Province of residence was not statistically significant.

In comparison to the empty model, the variation in occurrences of adolescent mortality was significant across communities $\tau = 1.697$; $p<0.05$. The intra-community correlation was 50.1% indicating that the clustering of the outcome variable across communities was as a result of the composition of the communities by household level characteristics.

Model III shows the results of the effects of community variables. All the community variables are positively and significantly associated with all- cause adolescent mortality. The likelihood of experiences of all- cause adolescent

mortality increases in rural areas 1.18 more compared to urban areas. Community poverty is significantly associated with all cause adolescent mortality. Living in communities with high proportion of poor households is associated with higher odds of adolescent mortality. Results further showed communities with a high proportion of racial diversity are 1.15 times more likely to experience adolescent mortality than areas of low racial diversity. Compared to model II the variation in adolescent mortality across communities remained significant $\tau = 2.541$, $p = 0.05$. The intra-community correlation was 43.9%, indicating that the clustering of adolescent mortality between communities was as a result of the composition of the communities by community characteristics.

Table 2: Multilevel logistic regression odds ratio of the effects of individual and community factors on adolescent mortality, South Africa, 2001

Characteristics	Model I Empty model	Model II Individual	Model III Community	Model IV Individual & community
		OR	OR	OR
Fixed effects				
Household characteristics				
Assets				
Low		1		1
Middle		1.31*		1.17
High		1.13*	-	1.27
Income				
Low		1		1
Average		1.09*	-	0.91*
High		0.87*		0.61*
Number of people living in residence				
Less than or 5		1	-	1
More than or 6		1.17*		1.17*
Tenure				
Owned		1		1
Rent		0.98		1.13*
Occupy, rent- free		1.06		1.007*
Province of Residence				
Eastern Cape			1	1
Free State			0.94	1.01*
Gauteng			0.77	0.78
KwaZulu-Natal			0.72	0.75
Mpumalanga			0.98	1.04*
North West			0.73	0.76
Northern Cape			0.95	0.97
Limpopo			1.11	1.17
Western Cape			0.83	0.87
Type of place of residence				
Urban			1	1
Rural			1.18*	1.11*
Community Characteristics				
Poverty				
Low			1	1
Medium			0.96*	0.97*
High			0.93*	0.63*
Racial Diversity				
Low			1	1
Medium			1.07*	1.05*
High			1.15*	1.11*
Random effects parameters	Empty	Individual	Community	Individual/ Community
Community level				
Variance (SE)	10.921* (2.905)	1.697*	2.541* (0.766)	2.048*
VPC=ICC (%)	70	-1.042	43.9	-0.992
PCV (%)	Reference	50.1	52.9	38.7
		63.2		81.6
Log-likelihood	-7265	-5406.1027	-6983.7326	-5545.3864
Model fit statistics				
AIC	15,215.50	16,316.00	13,336.60	13,650.20
BIC	15,339.00	16,339.20	13,581.40	13,795.60

The final model model IV contains both the household and community variables. Results show that the inclusion of community variables had independent effects on adolescent mortality as well as moderating effects on the association between household factors and adolescent mortality. For example, assets are no longer statistically significant, now that community variables have been added.

The results of this model show high income households had the lowest odds of experiencing adolescent mortality at 0.61. In addition, household with more than or 6 resident members were still more likely to experience adolescent mortality compared to households with 5 residents or fewer. In addition, tenure shows that households which are not owned, rented or occupied for free have higher odds of experiencing adolescent mortality. Province of residence shows some statistical significance compared to Model II. Here it is seen, that the odds of all cause adolescent mortality is almost even in the Free State and Mpumalanga provinces.

Further, the results showed that living in rural communities with high proportion of racial diversity was associated with higher likelihood of all cause adolescent mortality in South Africa in 2001. However living in communities with a low proportion of poverty as measured by household income in communities was associated with decreased odds of adolescent mortality.

Comparatively the variance at the community level in model IV remained significant $\tau = 2.149$; $p<0.05$. The intra-community correlation decreased to 38.7% indicating that the inclusion of community variables was important for obtaining a better explanatory model. The clustering of the likelihood of adolescent mortality at the community level is as a result of the composition of the communities by community characteristics. Further, it also indicates that part of the clustering between communities was due to the composition of communities by household characteristics.

Discussion

This study sought to identify the household and community factors associated with adolescent mortality in South Africa. The study found that having a few household assets, six or more people living in a residence, and high racial diversity was associated with increased odds of adolescent mortality in South Africa in 2001.

It is well- known from existing literature that a child's health can be compromised in large households. According to Amoateng and Heaton "social and financial resources may not be adequate to accommodate each individual's emotional and economic needs. Household size is particularly critical in poor areas where the demands placed on large families are often difficult to absorb because of widespread impoverishment"[14]. As a result of this, children in large families are vulnerable to malnourishment, failure to recognise illness, inadequate attention and unsanitary living conditions[14]. Since adolescence is the time of transition from childhood to adulthood, it is expected that some of the determinants of poor child health, such as large household size, would also be determinants of poor adolescent health.

To clarify the finding on racial diversity, it is important to note that in South Africa, the Population Registration Act of 1950 coined the phrase 'population group' and demarcated the population into four races or ethnicities. The term 'population group', which has both social and biological connotations, has become the standard analytical concept in public discourse. According to the 2001 South African population Census, Africans are the largest group comprising 79.02% of the total population. The other races are White, Coloured and Indian/Asian[15]. This study examined the odds of adolescent mortality in communities where the population groups are mixed and thus found in areas with high racial diversity or mix, the odds of all-cause mortality are higher. South Africa's past Apartheid policies of racial segregation meant that racial or racial groups were forced to live together. Since the end of Apartheid, South Africans have been free to move and live wherever they want to. This created some communities of racial diversity. For those moving into previously racial -homogenous communities and thus creating diversity, they are separated from family, community and social support structures. The health outcomes of such people are then arguably the same as immigrants who leave family and 'home' behind. Research has found that immigrants suffer worse health outcomes because of the loss of support and the restricted access to healthcare in new areas[16].

Conclusion

The overall objective of this study was to assess the extent to which contextual factors account for variations in regional patterns of adolescent mortality. The South African Census of 2001 was used. The household variables were confined to the characteristics reported by the living

household member. Further, for community variables, only community poverty created through household incomes in a community and racial diversity created through the population group/ race of the household head were used. In order to fully realise the extent to which contextual factors account for regional variations in adolescent mortality, there are more characteristics that are needed, for example, number of schools and hospitals in the community. Given the variables that were used, this study was successful in showing that poverty and high racial diversity are associated with increased mortality among adolescents in such communities in South Africa.

In evaluating the research implications of the study, first the difference between this and other studies needs to be made. This study is the first on the contextual determinants of adolescent mortality in South Africa. While a study has been found on the individual level determinants of adolescent mortality, it was published in 1992 and examined only external causes of death among the White, Coloured and Indian/Asian populations of South Africa from 1982 to 1986[4]. Some more recent work on adolescent mortality in South Africa has also been on the levels, causes and individual level determinants[17,18].

The results of this study would be of interest to the department of social development since this study shows the environmental household and community determinants of adolescent mortality. For the department of social development these results are instrumental to programmes aimed at ensuring the full development of adolescents into healthy adults. Second, the results would be of interest to parents, caregivers, teachers and other parties invested in the survival and development of adolescents.

Limitations

A limitation of the study, is the issue of temporality. Due to the cross-sectional nature of the data, the timing of the recording of the death and household and community factors were at the same time. So there is no indication of whether the death preceded these factors or came afterwards. As such causation between household and community factors and mortality could not be established.

Finally, policy should take into account the challenges faced by low income households and rural communities, in light of the effect these areas have on adolescent mortality. This is identified as an aim of the Policy on Quality in Health Care for South Africa[19]. Healthcare availability and utilization in such areas should be carefully mapped and better understood. In addition, the type of care available to low income and rural communities should be addressed.

Conflict of interest

We have no conflict to disclose.

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