

SPATIAL CORRELATIONS IN FAMILY AND NUTRITIONAL HEALTH STATUS OF CHILDREN IN SOUTH AFRICA

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Abstract: Child health outcomes continue to interest academic inquiry and policy attention at national, regional and global levels. Investigations on child health in South Africa depict that mortality rates have since lowered over time and morbidity trends have also transitioned. Meanwhile, the family structures of South Africa have transitioned further away from nucleation, but the extent to which this has impacted on the health status of the surviving children has not yet been systematically investigated and quantified. This quantitative study will therefore investigate the extent to which the family structures found in South Africa impact on the nutritional health status of children. Data from the 2016SADHS will be used, the study will employ multivariate regression analysis to estimate the unadjusted and adjusted health index-effects of family structure. Results will therefore show measured and quantitative outcome of the SDG3 goal of how healthy the children are in South Africa

Background

The health outcomes of children continue to interest academic inquiry and policy attention at global, regional and national levels (Hall et al., 2014; Martin et al., 2018). The global formal prioritisation of child health dates from 1990 UN convention of the Human Rights of children where emphasis was put on every child having the right to survive within a conducive environment in the context of a family or cultural grouping (Bradshaw et al., 2003). The global Millennium Development Goals (MDGs) framework, whose timeline was 2000-2015, was succeeded by the Sustainable Development Goals (SDGs) framework which guides regional and national level health policies and goals for the period 2016-2030. The SDGs shifted the focus from just keeping children alive (reducing under five mortality (U5M), leading causes of mortality and preventable diseases) to achieving optimal health through the 'survive, thrive and transform' global agenda which promotes good health for all persons at all ages by 2030/35 (A. Goga et al., 2019; International Council for Science and International Social Science Council, 2015; Schmidt et al., 2015; United Nations and General Assembly, 2015). SDG3 in particular puts emphasis on ensuring healthy lives and promoting wellbeing for all at all ages (Kumar et al., 2016; Schmidt et al., 2015; United Nations and General Assembly, 2015). The achievement of this goal is centred on ensuring that every citizen begins their life especially in the first 1000 days with the best health status possible (Delany et al., 2016; Jamieson et al., 2011; Mathews et al., 2014). This is attainable by prioritising child health which acts as the basic foundation to achieving long, healthy and productive lives (Bradshaw et al., 2003; Case et al., 2005; Coll-Seck et al., 2019).

The South African government has responded to the global shift from MDGs to SDGs framework by adapting child and maternal health policies aligned to the new global framework. This adaptation has had positive implications as seen by the overall South African scenario and outlook of child health status post-2010 era, which has mostly been associated with reduced mortality and morbidity rates and indicators (Bamford et al., 2018; Chopra et al., 2009a; A. E. Goga et al., 2019). Notable governmental interventions and policies implemented encompass

the Prevention of Mother to Child Transmission (PMTCT) programme which also gave way to expanded immunisation policies, withdrawing of commercial infant formula for HIV exposed infants (Development, 2012; A. E. Goga et al., 2019; Pillay-van Wyk et al., 2016). These interventions were informed by research on cause specific data that highlighted that the major contributors to the mortality rates (also most prevalent diseases) among children are HIV/AIDS, low birth weight, pneumonia, diarrhoea, lower respiratory infections and protein energy malnutrition (Bamford et al., 2018; Boyden et al., 2019; Bradshaw et al., 2003; Burgard and Treiman, 2004; A. Goga et al., 2019; Pillay-van Wyk et al., 2016). To effectively curb these indicators social scientists debated on the need to go beyond disease treatment and rather investigate social factors that are pivotal in determining overall child health and mortality (Bartley et al., 2006; Braveman and Gottlieb, 2014; Marmot, 2005; Wilkinson and Marmot, 2003). Existent social status quo on the South African children is not favourable to child health outcomes and further undermines child nutritional status, clearly working in synchrony to ultimately denigrate the overall health status in a child ; 61.2% of children are multidimensionally poor, 45% live with one parent while a further 21% have no parents, 62% live in rural areas and they are raised up in the environment which has a legacy of family disruption (Delany et al., 2016; Maluleke, 2020; May et al., 2020; May and Lake, 2020). A review on existing body of literature and investigations have concluded that such social determinants are detrimental to child health outcomes and that basically the health status of a child is greatly impacted on by a combination of family circumstances, and the social environment surrounding them (Biasci et al., 2019; Boyden et al., 2019; Braveman and Gottlieb, 2014; Spencer, 2018).

Basing on this evidence, the South African government had to find means to successfully curb morbidity and mortality burden. To effectively implement policies and find means of reducing burden of disease and mortality among children, there was need for a collaborative effort from all parties and departments (Dinbabo, 2016; A. E. Goga et al., 2019). Notable legislative developments have been implemented over the years, The White Paper on Families (2013) recognised the family as basic social unit responsible for child outcomes, hence there was need to mainstream family issues in order to foster positive family well-being and overall socio-economic development in the country; this meant placing the child within the family and not viewing it from the macro perspective (Brown et al., 2015; Development, 2012; Martin et al., 2018). Faced with the predicament and high levels of poverty which have also been observed to have consequences/ cascading ripple effects on overall child health indicators, the Government through Department of Social Development (DSD) issued responsive targeted policies targeted at providing economic and social protection, reducing HIV/AIDS burden and promoting families (Armstrong and Burger, 2009; Boyden et al., 2019; Dinbabo, 2016). The Social assistance amendment bill (2020) as well as the Children's amendment Bill (2020) all form part of the initiatives aimed furthering the social assistance grants as well provisions for care and protection systems for the children in the most vulnerable circumstances (Martin et al., 2018; May and Lake, 2020). In the face of "slow violence of nutrition" among South African children, the DoE in partnership with local NGOs also implemented National School Nutrition Programme (NSNP) program (to improve nutritional status of children in the school going age (Karriem, 2018; May et al., 2020). The Birth and Deaths Registration Act (2013) play a pivotal role in ensuring documentation of vital statistics and further monitoring of

indicators and tracking the child population size (Hall et al., 2014; Martin et al., 2018; May et al., 2020). The guiding and the underlying principle of the policies enacted in South Africa are highlighted in The Constitution of the Republic of South Africa (1996) which is the overarching institutional framework that guides the implementation of South Africa's policies and legislation, Section 27 particularly enshrines the right to healthcare, food, water and social security (Development, 2012; Republic of South Africa (RSA), 1996). All these interventions targeted to improve child health in the social contexts they are natured encompassing the family and well as the environment surrounding them.

It is evident that a burgeoning body of international literature acknowledges the impact of social characteristics in determining the health outcomes, of particular interest are the studies conducted by family demographers that are mainly concerned with studying families. Their intersection with health demography has been evident in studies which sought to link the health of children to certain types of family structures (Brown et al., 2015; Crouch et al., 2016a; Witt and DeLeire, 2009). Evidence from these scholarly studies points out that the family circumstances in which a child is reared and nurtured plays a crucial and critical role, because children are entirely dependent on the environment and the family they are found in, hence their health status is also a reflection of the family's wellbeing (Anderson, 2014; Brown et al., 2015; Martin et al., 2018). Some studies that further intersect family demography and health demography acknowledge that child survival and morbidity are linked with certain types of family structures hence the family structure or composition is a fundamental covariate in determining child health outcomes (Brown et al., 2015; Crouch et al., 2016a; Witt and DeLeire, 2009). The effect of family structure on child outcomes are well documented, as studies have exhaustively looked into health covering the aspects of physical, psychosocial development (Anderson, 2014; Brown et al., 2015; Coll-Seck et al., 2019; A. Goga et al., 2019; Ntoimo and Odimegwu, 2014; Schrijner and Smits, 2018). Research evaluating the impact of family structure on the health and well-being of children demonstrates that children living with their married, biological parents consistently have better physical, emotional, and academic well-being (Anderson, 2014; Banda et al., 2017; Ntoimo and Odimegwu, 2014). Furthermore, studies that have looked into nuclear families proved that children raised in nuclear families fared well and had healthier outcomes in comparisons to those raised in non-nuclear settings (Anderson, 2014). South Africa on the verge of family transition is highly marked with prevalence in absenteeism of biological parents, the 2018 GHS study found that 20% of the children in SA do not reside with either of their biological parents, 43% of children reside in single mother headed families, 3% live with their fathers and not the mothers (May et al., 2020). These prevalent and dominant family structures in South Africa have been shown to be significantly correlated to unhealthy child outcomes overall. The combined effects of the prevailing social status in which children reside in and are reared in also is significant in determining child health. While a body of literature has contributed into investigations on family structure in relation to the morbidity and mortality, there is however a need to investigate how this structure impacts on the absence of disease among children thus serving as a proxy for overall health status.

Coverage of child health has been investigated at both policy and academic platforms. Surveys and research from institutions such as Statistics South Africa (StatsSA), The National Burden of disease study and Committee on Morbidity and Mortality in Children Under Five Years

(COMMIC), and The South African Medical Research Council (SAMRC) augment the data on child health in South Africa (A. E. Goga et al., 2019; Statistics South Africa, 2016). Trends dated from 1997 show that mortality rates have since declined (Pillay-van Wyk et al., 2016). Although the neonatal mortality rate in South Africa has remained stagnant at 12 deaths per 1 000 live births, the infant and under-5 mortality rates have significantly declined since peaking in 2003 (Bamford et al., 2018; A. E. Goga et al., 2019; Liu et al., 2016; Pillay-van Wyk et al., 2016). Estimates showed that in 2007 U5M was 66.9 in every 1000 children, this subsequently declined in 2016 as DHS data estimated that 42 in every 1000 children die before their 5th birthday (Bamford et al., 2018; Hall et al., 2014; Health and ICF, 2019; Pillay-van Wyk et al., 2016). While these rates show an improvement, policy makers and researchers are still fixated and concerned on the fact that these rates are still considerable high according to global standards (Bamford et al., 2018; Draper et al., 2019). Some scholars on the other hand acknowledge that indicators of negative health status among children such as lack of physical activity, inadequate nutrition and stunted growth continue to exist among children in South Africa post 2015 (Draper et al., 2019; May et al., 2020). It is estimated that between 1999 and 2017 for example, stunting has rates have remained above the 20% mark (May and Lake, 2020). This raises arguments concerning the gap between policy guidelines and implementations (Bradshaw et al., 2003; Draper et al., 2019; A. E. Goga et al., 2019).

While research and data depicts observed improvements in selected health indicators in the South African context in comparison to other countries in the region, of major concern is the fact that these rates are still lagging behind into attaining of the SDG's (Braveman et al., 2005; Hall et al., 2014; Kumar et al., 2016). Existent within country disparities and inequalities by province, rural/ urban residence, social gradient and family composition and family structure also prove contribute to the overall negative health implications of children (Braveman et al., 2005; Burgard and Treiman, 2004; Delany et al., 2016; Hall et al., 2014). Basically the mortality indicators on one hand are reflective of improved survivorship and on the other hand the social determinants on the ground do not favour good health outcomes (Burgard and Treiman, 2004; Delany et al., 2016; Development, 2012; Marmot, 2005; Pillay-van Wyk et al., 2016; Seekoe, 2015; Spencer, 2018; Statistics South Africa, 2016). There is therefore a need to quantify the exact measure of overall child health status and measure the absence of disease among the children who have since survived as reflected by the mortality indicators. This will build on the knowledge that an improvement of the indicators is not a clear indication of the child health status of the surviving children. Health status of a nation, particularly in the beginning of the life course (0 to 5 years) plays a pivotal role in depicting the development of health institutions and predicting the wellbeing of the future generations. The paper builds on the goal of child health and development unit whose objective is to end preventable child deaths and promote healthy growth of all children as they develop to adulthood. This study therefore aims to investigate the extent to which the family structures found in South Africa impact on the multiple nutritional health outcomes among children (stunting, wasting, underweight and obesity)

Deficiencies in literature

Literature on child health has mostly been biased towards investigating child health indicators contributing to the highest levels of morbidity and mortality cases (Abreha et al., 2020; Ataguba et al., 2015; Bamford et al., 2018; Bradshaw et al., 2003; A. E. Goga et al., 2019; Pillay-van Wyk et al., 2016; Said-Mohamed et al., 2015; Wang et al., 2017). This has meant that children's health indicators (nutrition, child mortality, immunisation, and treatment of diarrhoea) have been investigated in separation (Abreha et al., 2020; Akinyemi et al., 2016; Banda et al., 2017; Cha et al., 2015; Chadoka-Mutanda and Odimegwu, 2017; Mejía-Guevara et al., 2019; Said-Mohamed et al., 2015; Schrijner and Smits, 2018). Other studies that have also looked into non-anthropometric indicators such as pneumonia and anaemia have also done this in isolation as proxies child health status (Abreha et al., 2020; Fischer Walker et al., 2013; Moore et al., 2020; Zar et al., 2020). These studies have made immense contribution in the child health literature in understanding the drivers of the main causes of mortality and morbidity. However, there is a gap in scientific studies which have not looked at the level of health status among children taking into cognisance that child health is indicative of an interplay of other recorded diseases as a whole. An investigation into health status of children measured as absence of recorded and reported diseases is essential. While social determinants of child health have been investigated, a growing body of literature acknowledges the pivotal role of family structure on impacting child health, however in South Africa the bias has leaned towards households headed by single mothers and grandmothers (Clark and Hamplová, 2013; Ntoimo and Odimegwu, 2014; Olamijuwon et al., 2017; Schrijner and Smits, 2018; Witt and DeLeire, 2009).

Purpose Statement

The purpose of this quantitative study will be to investigate the social determinants of nutritional child health status in South Africa. The study will mainly focus on understanding the impact of family structure on the nutritional health status of children aged below 5 years in South Africa. The dependent variable in the study is nutritional health status. The state of nutritional wellbeing will be indicated by a nutritional health index which will be derived from data about nutritional status collected in SADHS2016. The main independent variable will be family structure which will be operationalised through household members' relationship type to the household head. Family structure will be derived at the household level. Control variables will be at community, household and individual levels. The community variables will be province and place of residence. Household variables will be socio-economic status, religion, social grant reception, meals per day, employment status. Individual factors are age, sex, population group, immunisation status and breastfeeding

Research Questions

To what extent does family structure explain nutritional health status of children in South Africa?

Specific Research Questions

- What is the index of nutritional health among children aged 0-5 years in South Africa?
- What are the associations between family structure (nuclear, female and male headed single parent) and the index of nutritional child health?

- To what extent does family structure interact with geographical, socio cultural and economic variables to affect nutritional health status among children

Significance of the Study

Child health is of paramount importance therefore prioritisation and focus should be directed at reducing mortality and morbidity cases among children (Coll-Seck et al., 2019; A. Goga et al., 2019; Liu et al., 2016). This entails ensuring healthy lives and promoting wellbeing among children (Biasci et al., 2019; Crouch et al., 2016a; You et al., 2015). To comprehensively achieve set targets and milestones, there is need for a quantitative study that investigates and presents a rounded and holistic approach on overall nutritional status of children in South Africa. The benefit of this will be in understanding child health beyond knowledge of simply absence and presence of leading causes of child morbidity and mortality.

Other studies in developing countries have investigated child health in silos concentrating at either anthropometric indicators (nutritional status, immunisation, treatment of diarrhoea and mortality) or non-anthropometric indicators (pneumonia, ARI) (Abreha et al., 2020). These indicators have been treated in isolation yet they are all measures of child health, this study will therefore build on the existing dearth in literature and investigate health inclusive of all anthropometric and non-anthropometric indicators as measures of overall child health status in South Africa.

South Africa has high levels of income inequality, inequalities in health and health outcomes all of which are to colonial era and apartheid legacy (Ataguba et al., 2015; Seekoe, 2015). The Negotiated Service Delivery Agreement between Minister of Health and the President recognises and highlights the need for addressing all plausible Social Determinants of Health (Commission, 2011; Mbeki et al., 2013; Zarenda, 2013). This study therefore contributes on evidence to redress existing health inequalities especially on the most vulnerable group of children aged between 0 to 5 years. Results from such study contribute to the planning of context specific policies that aim at improving child health as well as those that provide comprehensive set of services and benefits designed specifically to support children in different kinds of family structure.

Theories and conceptual Framework

This research will be guided by two theoretical frameworks namely the Mosley and Chen Analytical Framework on child survival (Mosley and Chen) and the social determinants of health framework to examine social factors which impact in shaping health across a wide range of health indicators, settings, and population' (Bartley et al., 2006; Braveman and Gottlieb, 2014; Marmot, 2005; Wilkinson and Marmot, 2003). The analytical framework for the study of child survival in developing countries was intended to advance research on social policy and medical interventions to improve child survival (Mosley and Chen, 2003). The approach incorporates both social and medical science to provide for measures of morbidity and mortality which are then analysed as a single variable. The model highlights 5 groups of proximate determinants that operate on the health dynamics of a population. The proximate

determinants, or intermediate variables that directly influence morbidity and mortality are maternal factors, environment contamination, nutrient deficiencies, injury and personal illness control.

The Social Determinants of Health (SDH) framework was originally used to explain social causes of illness, health inequalities and premature deaths (Bartley et al., 2006; Braveman and Gottlieb, 2014). The global concern on health challenges has been fixated on gross health inequalities within and between countries, all these culminate impact on overall health, life expectancy and quality of life lived by individuals (Marmot, 2005). These factors are neither medical nor clinical but contribute in determining health inequality and outcomes among individuals (Currie et al., 2009). The framework basically highlights distal, intermediate and proximal factors that work in synchrony to ultimately impact on child health outcomes or inequalities, these structures are the fundamental drivers of the conditions in which people are born, grow and work (Braveman and Gottlieb, 2014). The original framework noted that included in the structural determinants are factors such as policies, social class, gender and employment which all work through intermediary determinants to influence health inequality among individuals (Bartley et al., 2006; Braveman and Gottlieb, 2014; Currie et al., 2009; Gilson et al., 2007).

Studies have used the social determinants of health framework in determining child health (Badland et al., 2014; Braveman and Gottlieb, 2014; Coovadia et al., 2009; Ruger, 2004). These studies have mostly investigated the impact of geospatial differences, social gradient, poverty and ethnicity in determining child health. The same framework has been adopted in investigating social determinants of health inequality even in the South African context (Ataguba et al., 2015; Coovadia et al., 2009; Scott et al., 2017). Results from these investigations have delineated the impact of factors such as race, poverty and gender violence in impacting overall health among South Africans (Coovadia et al., 2009). As a build up to the available literature, the impact of the family structure as a pertinent social determinant of child health is necessary. Studies that have specifically looked into family structure have mostly done so with the main aim of measuring observed differentials among single mothers or fathers on the outcomes of their children (Clark and Hamplová, 2013; Ntoimo and Odimegwu, 2014; Olamijuwon et al., 2017).

2.2 Conceptual Framework

This conceptual framework for this study will be guided by the literatures that have investigated child health inequalities and outcomes with reference to the social determinants of

health (Akinyemi et al., 2016; Ataguba et al., 2015; Chopra et al., 2009b; Currie et al., 2009; Scott et al., 2017). This study conceptualises that there is a relationship between family structure and child health status. This relationship is not independent from the distal determinants at the structural and community-level as well as living conditions. These factors influence the extent to which family structure operates through proximate determinants to impact on child health status. which impact on intermediary/social traits through the observed proximal factors to ultimately influence the child health status which is expressed as the child health index.

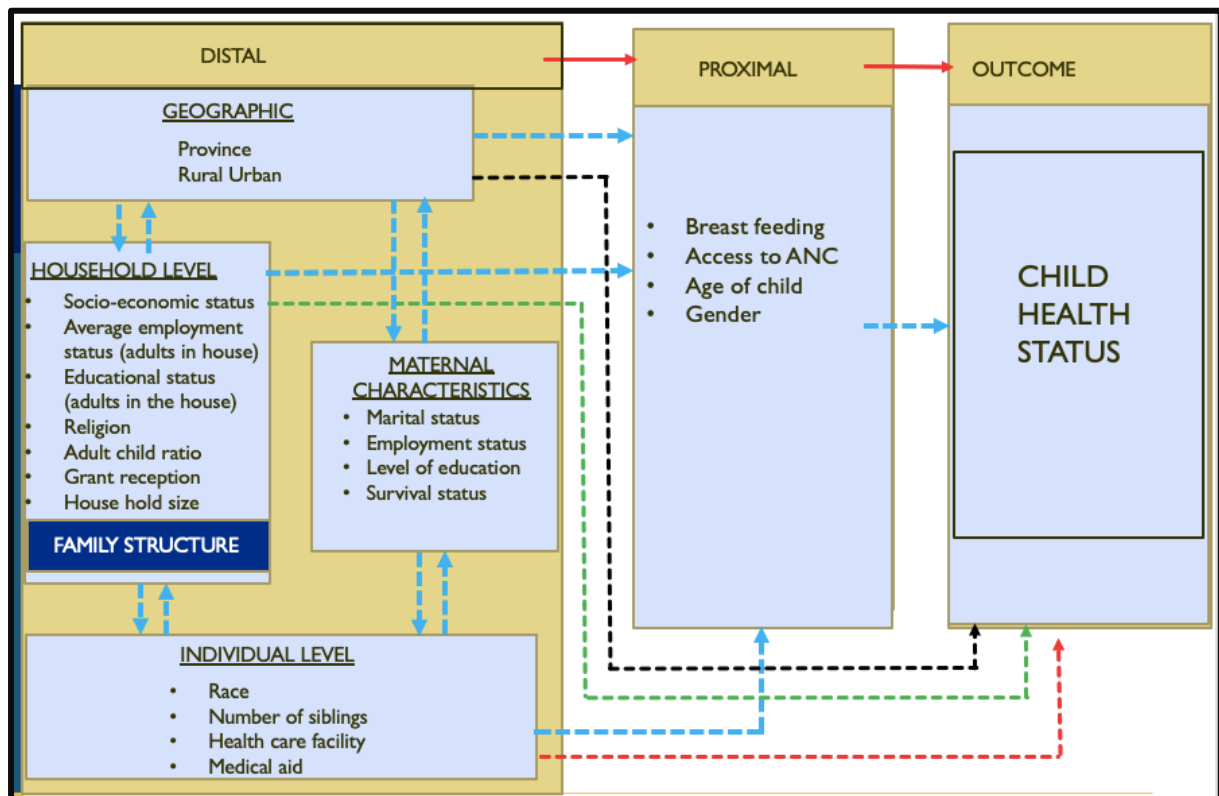


Figure 1: Conceptual framework adapted from SDH and Mosley and Chen frameworks

The basis of the study is that the family or household bears the primary responsibilities for caring and providing for children, protecting them from harm and promoting their overall health (Hall et al., 2014). Children, especially those aged below five years, are entirely dependent on their families for their wellbeing. As a result, family structure is therefore pivotal in determining child health however this is a micro structural and intermediate variable that is also influenced by community and household variables. Distal factors that also serve as the community variables are determined by the province and place of residence (rural or urban) are associated with livelihood traits. Urban settlements are usually accompanied with high levels of industrialisation, pollution, hub of inwards migrants, criminal activities and low

immobility(exercise) and fast-food nutrition; this livelihood is therefore accompanied with high prevalence of non-communicable and infectious disease. Other studies argue that basing on major health issues habitats in rural settlements are bound to have worse health outcomes compared to urban settlers (Eberhardt and Pamuk, 2004).

Household characteristics such as socio-economic status and grant reception are proxy measures of the poverty in the family(Armstrong and Burger, 2009; Boyden et al., 2019; Spencer, 2018). Financial injection in the form of social grants to the household influences the lifestyle, nutrition thus meaning the individuals and children in the family have a better social standing. Evidence from studies suggests that the poorer the people the worse the health outcomes and the higher the probability of dying (Bartley et al., 2006; Gilson et al., 2007; Spencer, 2018). Religion also impacts on individual behaviour and health seeking behaviour of individuals and care givers which ultimately impacts on child health.

The conceptual framework as shown in Fig 1 illustrates that distal factors working through intermediate and proximal factors to ultimately influence the outcome of the health status of a child. Evidence drawn from South African based studies conceptualises that family structure as the basic social unit in itself is accompanied with traits that directly/indirectly influence child health outcomes that are inclusive of both physical and mental health (Hall et al., 2014; Makiwane et al., 2017; May et al., 2020; Ntoimo and Odimegwu, 2014; Olamijuwon et al., 2017). Results from other studies showed that coupled families stand out to be at an advantage financially and socially thus resulting in better child outcomes (Brown et al., 2015; Crouch et al., 2016b). Households headed by female single parents have been reported to be responsible for raising the highest proportion of the South African children (43.1%), are associated with highest level of poverty, malnutrition, mental and physical health as well higher likelihood of mortality (Cheng and Wu, 2016; Hall et al., 2014; Martin et al., 2018; May et al., 2020; Ntoimo and Odimegwu, 2014). Health outcomes measured in terms of nutritional status and marasmus indicated an association of single parenting with ill health among children aged below 5 years (Clark and Hamplová, 2013; Olamijuwon et al., 2017). The family therefore responds actively to the environment and acts as the source to provide care for its members, these factors not only affect primary care giver but consequently impact the nurtured children and their physical, mental and social wellbeing.

In South Africa, the population group of an individual has shown to be significantly associated with one's livelihood (Coovadia et al., 2009; Seekings and Nattrass, 2005). Studies on racial differences in South Africa race acted independently of other demographic factors to adversely affect health thus blacks had a higher probability of ill health and mortality rates (Burgard and

Treiman, 2004; Seekings and Nattrass, 2005; Williams et al., 2008). Due to the effects of apartheid inequality and discrimination on ethnic grounds is evident resulting in generational poverty and wealth (Maluleke, 2020; Seekoe, 2015). The age variable has also been noted to be associated with child health outcomes, a study that reviewed nationally representative data in South Africa found that one-third of all the under 5 deaths occur in the first year, this also parallels cause specific data which alludes to diarrhoea, pneumonia and HIV being the cause specific contributors, these studies therefore show that the first year in a child's life is associated with higher likelihood of morbidity and mortality cases (Bamford et al., 2018; A. E. Goga et al., 2019; Pillay-van Wyk et al., 2016).

All these studies allude to the hypothesis that a myriad of factors, all based on the fundamental family structure variable work in synchrony from distal, intermediate and proximal determinants to influence the overall child health status. The individual variables therefore directly determine the child health index. The study will therefore seek to regress child health index against household family structure while controlling for other variables.

Methodology

Data

Research data will be obtained from the South African Demographic and Health Survey 2016 (SADHS2016). The survey was conducted by Statistics South Africa (Stats SA), in partnership with the South African Medical Research Council (SAMRC) on request by National Department of Health (NDoH). The DHS collects information on socio-economic, demographic and health from household proxies. These data are used to track demographic changes such as health and family transition

Survey design

The SADHS2016 is a nationally representative cross-sectional study that interviewed women and men aged between 15-49 years in the individual interviews. Children aged 0-59 months were eligible for biomarker collection. The main objective was to come up with an updated estimate of basic demographic and health indicators and highlight key health aspects of child health such as immunisation coverage and prevalence and treatment of acute respiratory infection, fever and diarrhoea. The SADHS employed a stratified two-stage sample design with a probability proportional to size sampling of PSUs at the first stage and systematic sampling of DUs at the second stage and the last sampling unit is the individual eligible to be selected for the survey.

The population and sample

In this study the study population will comprise of all the children aged between 0 to 5 years, the sample will therefore be limited to a total number of 4135 children aged 0 to 5 years that were enumerated in the SADHS 2016 survey. Data on these children was reported on by parents and in instances where the biological mother was deceased the caregiver questionnaire was administered on the caregiver.

The instruments

SADHS 2016 used five questionnaires in total: the Household Questionnaire, individual woman's, the individual man's questionnaire, the caregiver questionnaire and the biomarker questionnaire. All these questionnaires were based on the DHS standard Demographic and Health Survey questionnaires and adapted to reflect the population and health issues relevant to South Africa. All questionnaires and consents were prepared in English and translated into South Africa's 10 other official languages. Basic demographic and health indicators were collected. For this study, the data of interest will be drawn from the household questionnaire, the individual questionnaire and caregiver questionnaire are used to collect data about the children and data about the house.

Variable identification

The dependant variable in the study is the nutritional health index, Child health will therefore be defined as the physical wellbeing of child aged 0 to 5 years. Absence of any disease as reported and recorded in the DHS will be categorised as healthy status. The child health index will be derived through variable reduction of nutritional health indicators in the datasets. The variables will include anthropometric variables. Anthropometric variables that will be includes will be stunting(height-for-age), wasting(weight-for-height), Obesity(BMI) and underweight (weight-for-age). These variables will be utilised to derive the measure of health. Principal component analysis will generate model index that will be continuous variable and indicative of full spectrum of child health. The index will lie between -1 and +1; a positive index corresponds to a pro-rich distribution of 'good health' whereas a negative index corresponds to a 'pro-poor' distribution of good health.

The independent variables in this study will be from that SADHS 2016 and these are influenced by literature reviewed and the theoretical frameworks which suggested different pathways by which health can be affected. The variables will comprise of distal, intermediate and proximal characteristics and the child health outcome. Distal factors include grant reception, religion, health care facility, insurance coverage, household food security, drinking water, sanitation, electricity, cooking source, household size, immunisation, income, province, place of residence, regular refuse collection. Intermediate variables included in the study are educational status of parent, socio-economic status, employment, race, religion, and family structure. Family structure will be the main independent variable this will refer to the relationship to household head. The different types of family structure will be used in this study, these are single parent, nuclear, couple, extended, skipped generation, complex and "other".

Couple households comprise two individual's household head and partner and their biological children (inclusive of stepchildren). Single parent households refer to one parent of either sex and their biological children. Extended family structures refer to the household head with their spouse, biological children and at least one grandchild. Skipped generation will refer to family comprising a household head with a spouse living with grandchildren. Complex family structure will refer to the families that have at least one unrelated member in the household. Proximal factors that will be used in the study are comorbidities, breastfeeding, age, gender and access to ANC.

3.6 Steps in data analysis

The first step in data analysis will be to estimate child health index using all the illnesses collected in SADHS using principal component analysis (PCA). The PCA will enable the generation of a single continuous variable which will measure the health status of children after considering all the illnesses. The central idea of principal component analysis (PCA) is to reduce the dimensionality of a data set consisting of a large number of interrelated variables, while retaining as much as possible of the variation present in the data set (Jolliffe and Cadima, 2016). The first step in data analysis will address the specific objective number 1. The second step in data analysis will be conducting bivariate associations between family structure and child health status as well as between the control variables and child health status. The third step in data analysis will explore nested multilevel regression models estimating unadjusted and adjusted effects of family structure on child health status.

This last step will explore the extent to which the interaction between family structure and each of the control variables affects child health status. The addition of interaction terms to the multivariate multilevel regression will enable an expanded understanding of the circumstances which increase or decrease the positive impact of a given family structure on the child health status of children. For example, the interaction term involving family structure and province will allow the study to establish the inequality between the health status of children from Gauteng and Eastern Cape if these children live in similar family structure.

This quantitative analysis will be conducted using Stata15. Univariate analysis will show the percentage distribution of the study population by selected independent variables which may directly and indirectly influence child health. The background characteristics will be presented using descriptive statistics which will include percentages and frequencies of all selected variables in the study. The bivariate analysis will estimate the distribution of health scores by household head and selected variables in the study, this will be done using the T-test and Anova test. Results generated from these tests will be presented in the form of forest plots. Multivariate regression analysis will be employed to estimate the unadjusted and adjusted health index-effects of family structure, the analysis will show which variable explains differences in health main predictor variable by family type

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