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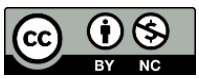

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Summary

The ‘leave no one behind’ (LNOB) principle is at the core of the 2030 Agenda for Sustainable Development and acknowledges that poverty is multidimensional and is an individual concept. Notwithstanding this, most empirical studies use the household as the unit of analysis for multidimensional poverty measurement. However, estimation of poverty levels at household-level underestimates poverty levels of the society and does not capture intra-household inequalities. The objective of this study is in twofold: (1) developing a country-specific individual-level multidimensional poverty measure; and (2) providing estimates of multidimensional poverty for Botswana. This study contributes to the conceptual operationalisation of the LNOB principle, which is applicable in any country context. Also, it adds to the literature on the multidimensional measure of poverty. Empirically, this study offers the first attempt to estimate a nationally relevant and context-specific multidimensional poverty index for Botswana using the individual as a unit of analysis. The results reveal multidimensional poverty incidence at an estimated 46.2 per cent. This figure is higher than the estimated monetary measure of 16.3 per cent, an indication that monetary measure alone does not reveal the real picture of the poverty situation in Botswana. The results show that on average, the multidimensionally poor are deprived in 47.4 per cent of all indicators under consideration. This finding indicates that multidimensional poverty intensity is also a considerable concern in Botswana. These findings warrant policy interventions.

Keywords: multidimensional poverty; inequality; Agenda 2030; leave no one behind; sustainable development; Botswana.

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Acronyms

AF	Alkire-Foster
AIDS	Acquired Immunodeficiency Syndrome
BIDPA	Botswana Institute for Development Policy Analysis
BMI	Body Mass Index
BMTHS	Botswana Multi-Topic Household Survey
BPC	Botswana Power Corporation
BPEPS	Botswana Poverty Eradication Policy and Strategy
CCDF	Complementary Cumulative Distribution Function
CSI	Coping Strategy Index
EA	Enumeration Area
ELCSA	Latin American and Caribbean Food Security Scale
FAO	Food and Agriculture Organization
FCS	Food Consumption Score
FGT	Foster Greer Thorbecke
FIES	Food Insecurity Experience Scale
HDDS	Household Dietary Diversity Score
HFIAS	Household Food Insecurity Access Score
HHS	Household Hunger Scale
HIV	Human Immunodeficiency Virus
HLP	High Level Panel
ICT	Information and Communications Technology
LNOB	leave no one behind
MFED	Ministry of Finance and Economic Development
MODA	Multiple Overlapping Deprivation Analysis
MPI	Multidimensional Poverty Index
NDP	National Development Plan
PPS	Probability Proportional to Size
PWD	Persons with Disability
rCSI	Reduced Coping Strategy Index
SAFS	Self Assessed Measure of Food Security
SB	Statistics Botswana
SDG	Sustainable Development Goal
SSU	Secondary Sampling Units
UN	United Nations
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
WHO	World Health Organization

1 Introduction

The worldwide adoption of the United Nation's Sustainable Development Goals (SDGs) in 2015, also known as the 2030 Agenda for Sustainable Development, has reinforced interest in multidimensional measures of poverty (UN 2016a). The SDGs are framed around ending absolute poverty (Alkire *et al*. 2015a), recognising that poverty has many forms and dimensions (UN 2015). Specifically, SDG 1, calls to 'end poverty in all its forms everywhere' (UN 2015: 14). Specifically, target 1.2 of SDG 1 states that: 'by 2030, reduce at least half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions' (UN 2015: 15), to leave no one behind.

The leave no one behind (LNOB) principle has emerged as a central theme of the 2030 Agenda of Sustainable Development (Fukuda-Parr and Hegstad 2018; UN 2015) and relates closely to three important dimensions of the 2030 Agenda: poverty, inclusiveness, and inequality (UN 2016a). LNOB aims to address two related concerns: ending absolute poverty in all its forms and reducing inequalities among both individuals and groups (UN 2015; Stuart and Samman 2017; Klasen and Fleurbaey 2018). The High-Level Panel (HLP) proposed that to leave no one behind there is need to ensure that 'no person – regardless of ethnicity, gender, geography, disability, race or another status – is denied basic economic opportunities and human rights' (UN 2013: 29). The LNOB principle acknowledges that poverty is multidimensional (UN 2015; Klasen and Fleurbaey 2018) and is an individual concept (Klasen and Fleurbaey 2018). It also acknowledges that data disaggregation to identify those left behind (UN 2015).

Notwithstanding this, most empirical studies on multidimensional poverty measurement have used the household as a unit of analysis (Franco-Correa 2014; Bessell 2015; Klasen and Lahoti 2016; Pogge and Wisor 2016; Rogan 2016; Espinoza-Delgado and Klasen 2018). Using the household as a unit of analysis means that if the household is multidimensionally poor, all members of the same household are considered poor (Angulo *et al*. 2016; Ervin *et al*. 2018; Espinoza-Delgado and Klasen 2018). This assumption implies that resources are equally shared and that deprivations experienced by any member of the household are simultaneously assumed by all household members (Haddad and Kanbur 1990).

Using the household as a unit of analysis is based on the following reasons. First, it makes the multidimensional poverty measure comparable to the official monetary poverty measure (Angulo *et al*. 2016; Ervin *et al*. 2018). Second, most deprivation indicators are defined at the household level (e.g. housing and living conditions, access to clean water and sanitation, among others). Third, targeting of most poverty interventions is at the household-level. However, even though most empirical studies used the household as a unit of analysis, it has not escaped criticism.

First, the 'household' means different things to different people in different countries, and defining it can be tricky and complex (Bolt and Bird 2003). The most widely used definition of a household is by the UN, which defines a household as 'a group of people who live and eat together' (Bolt and Bird 2003: 10). However, this definition may be problematic since individuals residing in the same household may have different living arrangements making it difficult to differentiate traditional households from other ones (Franco-Correa 2014).[1]

Second, using the household as a unit of analysis leads to underestimating levels of poverty in the society (Haddad and Kanbur 1990) because intrahousehold inequalities conceal deprived individuals within non-poor households (Brown *et al*. 2017), and this may, in turn,

[1] For example, in cases where one household member lives temporarily in two different households.

lead to biased assessments of social policies and targeting (Rodríguez 2016). Household measures are unable to capture possible intrahousehold inequalities in resource allocation (Vijaya *et al*. 2014; Alkire and Fang 2019), and to distinguish individual poverty within the household (Alkire and Fang 2019). Children and women are more likely to receive an unequal share of the resources or opportunities (Klasen and Lahoti 2016; Rodríguez 2016), indicating that resource allocation within households is uneven (Haddad *et al*. 1997). Individuals' needs and preferences vary across age (Osberg and Sharp, 2014) and gender (Vijaya *et al*. 2014; Pogge and Wisor 2016). Poverty is an individual characteristic (Deaton 1997), and therefore, deprivations that affect one household member do not necessarily affect all other household members.

Considering these limitations and in line with LNOB principle (UN 2015), the analysis performed in this study adopts the individual as the unit of analysis. In other words, this study measures and analyses poverty using a multidimensional poverty measure that captures individual deprivations to identify those left behind. The individual-level analysis allows for data disaggregation by demographic characteristics as required by the LNOB principle to identify those left behind. Individual centred approach eases policy-making exercises because it takes into account individual deprivations (Franco-Correa 2014), and this will help highlight priorities for particular groups in specific places to ensure no one is left behind.

Previous studies that considered individuals as a unit of analysis in multidimensional poverty measures mainly focused on children (Roelen *et al*. 2010; Roche 2013; Roelen and Camfield 2013; Trani and Cannings 2013; Roelen 2014, 2017, 2018; García and Ritterbusch 2015; Leu *et al*. 2016; Rodríguez 2016; Pinilla-Roncancio and Silva 2018; Qi and Wu 2019). Other studies that considered individuals as a unit of analysis in multidimensional poverty measures focused on some sections of the population such as women (Bastos *et al*. 2009; Alkire *et al*. 2013; Batana 2013) and adults (Mitra *et al*. 2013; Agbodji *et al*. 2015; Bessell 2015; Vijaya *et al*. 2014; Hanandita and Tampubolon 2016; Pogge and Wisor 2016; Rogan 2016; Chen *et al*. 2019). Studies that assessed individual-based multidimensional poverty across the entire population using the individual as a unit of analysis are very scarce (Franco-Correa 2014; Klasen and Lahoti 2016; Espinoza-Delgado and Klasen 2018). The scarcity of such studies could be as a result of the unavailability of individual-level data. Another reason could be associated with the conceptual and empirical challenges in the construction of individual deprivations (Vijaya *et al*. 2014; Klasen and Lahoti 2016).

To the best of my knowledge so far, only three studies have attempted to estimate individual-level multidimensional poverty for the whole population. The first study was done by Franco-Correa (2014) for the case of Chile, Columbia, Ecuador, and Peru. Following this study, Klasen and Lahoti (2016) examined the case of India, and the most recently Espinoza-Delgado and Klasen (2018) did the case of Nicaragua. However, these studies did not provide an in-depth analysis of poverty levels by different socio-demographic characteristics of the population. For example, Espinoza-Delgado and Klasen (2018) considered analysis by gender and age only while Franco-Correa (2014) examined multidimensional poverty across age groups.

The main objective of this study is to develop an individual-level and country-specific multidimensional poverty measure. Also, the study aims to provide a multidimensional poverty estimate for Botswana. The study employs the Alkire and Foster (2011a) methodology for aggregation and the absolute measure of inequality proposed by Alkire and Seth (2014a) to examine inequality among the multidimensionally poor. Botswana presents a salient case study. The country has made significant progress in reducing monetary poverty. However, Botswana has not had an equally impressive record in terms of other key social indicators such as unemployment, rising inequalities, among others, an indication that the country has not been successful in transforming national wealth into improvements in human development. The country has also committed to the SDGs and the LNOB principle. To the

best of my knowledge, this study constitutes the first attempt in Botswana and the African region to estimate the individual-level multidimensional poverty index and inequality for the whole population.

This study contributes to the conceptual and methodological aspects of the study of multidimensional poverty. The study also provides an attempt to operationalising the LNOB principle. Also, it adds to the literature on multidimensional poverty in Botswana. Empirically, this study offers the first attempt to estimate nationally relevant and context-specific individual-level multidimensional poverty for Botswana. The study is structured as follows: Section 2 presents data and methodology. Section 3 presents and discusses empirical results, and Section 4 presents robustness analysis. Last, Section 5 presents conclusions by discussing the main findings.

2 Data source and methodology

I present the data sources and methodology in this section. I discuss the data source in Section 2.1. Section 2.2 presents and discusses the proposed dimensions, deprivation indicators and cut-offs, while Section 2.3 discusses the weighting of dimensions. Section 2.4 discusses the approaches to aggregation (multidimensional poverty measurement and inequality measure). Last, I present and discuss the association between deprivation dimensions in Section 2.5.

2.1 Data sources

The analysis of this study utilises the 2015/16 Botswana multi-topic household survey (2015/16 BMTHS hereafter) collected by Statistics Botswana (SB). This survey is a cross-sectional and nationally representative survey, allowing for disaggregation by demographic characteristics, economic variables, and administrative district. The survey aims to provide a comprehensive set of indicators designed to produce multidimensional welfare indicators at both household- and individual-level to allow for enriched and in-depth analyses. The 2015/16 BMTHS collected socio-economic information on sixteen (16) topical modules covering a sample of households across districts and sub-districts. The main aim of the topical modules is to gather specific in-depth information. The topical modules include (but not limited to) on demographic characteristics, household expenditure and consumption, labour force, health, education, sources of income and social protection, self-assessed well-being and food insecurity, services within villages/community, housing, utilities, durable goods and livestock ownership, and anthropometric measurements (children under 18 years) (SB 2018).

The dataset contains information from 24,720 individuals from 7,060 households surveyed in 2015/16. After applying sample weights, this resulted in an estimated 589,909 households and an estimated national population of 2,073,675 individuals (SB 2018). The 2015/16 BMTHS individual population is comparable to the 2016 projected population of 2,219,736 estimated by SB (SB 2015). The survey employed a two-stage stratified probability sample design. The first stage was the selection of primary sampling units (PSUs), which were enumeration areas (EAs) using Probability Proportional to Size (PPS) where the measure of size is the number of households in an EA as defined in the 2011 Population and Housing Census. The second stage was the selection of occupied households within the selected EAs. A list of identified occupied households formed the basis of secondary sampling units (SSUs). Thus, the number of occupied households in each selected EA served as a sampling frame for that EA (SB 2018). Stratification was made based on the twenty-six (26) census districts which are heterogeneous. Furthermore, the districts were grouped into three strata: cities/ towns, urban villages, and rural areas (SB 2018).

In this study, I adopt the individual as a unit of identification. In terms of analytical strategy, this study classified the population of Botswana into four age groups: below 18 years (children), 18 to 35 years (youth), 36 to 64 years (adults) and 65 years and above (older persons). This classification is in line with the different policies for different age cohorts of the population. For example, the Botswana Children's Act, 2009 (Republic of Botswana 2009) was used to set an age threshold for children (0-17 years). I set the age threshold of 35 years to separate the youth from children and adults as per the 2010 Revised National Youth Policy (Republic of Botswana 2010) while the threshold of 65 years is set to separate older persons from adults. Table 2.1 presents the sample and population distribution by age groups. Botswana has a youthful population with children and youth accounting for a total of 70.4 per cent. These results are consistent with the 2011 population and housing census, where children and youth accounted for 71.6 per cent (SB 2013). Botswana aspires to have made significant investments in its youthful population to reap demographic rewards (Republic of Botswana 2016).

Table 2.1 Sample and population distributions 2015/16

	Sample		Population	
Age group	**Frequency**	**Per cent**	**Frequency**	**Per cent**
0–17 (Children)	**9,718**	**39.3**	**817,843**	**39.4**
18–35 (Youth)	**7,582**	**30.7**	**643,726**	**31.0**
36–64 (Adults)	**6,023**	**24.4**	**501,326**	**24.2**
65+ (Older persons)	**1,397**	**5.7**	**110,781**	**5.3**
Total	**24,720**	**100.0**	**2,073,675**	**100.0**

Source: Author's own, based on data from SB (2018)

2.2 Proposed dimensions, deprivation indicators and cut-offs

The capability approach, in conjunction with the consensus approach, informed the choice of dimensions and indicators (Alkire 2002). The decision was also informed by Botswana's policy commitments and development priorities such as Vision 2036, NDP 11, BPEPS and the SDGs, to ensure that the measure is contextually relevant. Finally, we considered data availability. As a result, I included the following seven dimensions in the multidimensional poverty measure: (1) *Assets*, (2) *Housing and living condition*, (3) *Water and sanitation*, (4) *Food security*, (5) *Health*, (6) *Education*, and (7) *Security*. The selected dimensions cover most of the indicators and dimensions of the global MPI (Alkire and Santos 2014), and the dimensions proposed in MODA child poverty study for Botswana (de Neubourg *et al*. 2015). They represent basic or elemental capabilities (Sen 1993, 1999).[2]

It should be noted that there are some conceptual and empirical challenges in the construction of individual indicators from those indicators defined and identified at the household level (e.g. housing and living conditions, water and sanitation and asset indicators) (Espinoza-Delgado and Klasen 2018). Most of these are public in nature within households (Klasen and Lahoti 2016). I follow other studies that attempted the individual-level multidimensional poverty measure in conceptualising these indicators (eg. Franco-Correa 2014; Klasen and Lahoti 2016; Espinoza-Delgado and Klasen 2018). The indicators are assumed to be true public goods, equally accessible to all individuals within the household (Klasen and Lahoti 2016; Espinoza-Delgado and Klasen 2018). The selected household-level indicators are included for their intrinsic and instrumental significance

[2] Key stakeholders decided the MODA dimensions during a workshop organised by BIDPA in Botswana given a country context and subject to data availability (de Neubourg *et al*. 2015). The dimensions included nutrition, health, education, housing, water, sanitation. I included all indicators used in MODA and nine of the ten indicators used in the global MPI.

(Klasen, 2000; Sen, 1999). Table 2.2 (presented at the end of this section) discusses the proposed dimensions, deprivations indicators, as well as the deprivation cut-offs, identification level and groups for which the indicators are applicable.[3] I describe each dimension and the corresponding deprivation indicators below.

2.2.1 Asset dimension

This dimension measures deprivations related to possession of household assets. This dimension provides insights into the household economic activity and reflects both past and future income-generating opportunities. In reference to the capability approach, assets are closely connected with ends (functionings) they facilitate (Alkire and Santos 2014). For instance, having a car or van constitute a functioning of 'being able to transport oneself'. Possession of durable goods is essential to perform every-day life activities and lacking certain goods can be understood as a manifestation of poverty (Townsend 1979). However, the use of asset indicators has proven to be both conceptually and empirically challenging in the construction of individual deprivations (Klasen and Lahoti 2016; Vijaya *et al*. 2014), as assets are shared and used across households. In conceptualising this dimension, household assets are assumed to be jointly owned and accessible equally to everyone within the household (Klasen and Lahoti 2016). I consider four deprivation indicators for this dimension.

The first deprivation indicator (*information*) assesses household deprivation in terms of access to information measured by the lack of possession of ICT assets. Information is vital to empowering the marginalised people and the poor. For example, in Uganda, the use of mobile phones by farmers increased market participation (Muto and Yamano 2009). In Botswana, most people use mobile phones as banking instruments to transfer money to their families. The government of Botswana, through radio and television, provides awareness about government programmes. According to Vision 2036, Botswana aspires for its people to enjoy equal access to information (Republic of Botswana 2016). The individuals residing in a household which does not own at least one of the following: radio, television, telephone (landline), mobile phone or personal computer/laptop are considered deprived in the information.

The second deprivation indicator (*durable goods*) captures the lack of possession of durable household goods. Household durable assets are integral to the functioning and attainment of well-being (Lerman and McKernan 2008). Durable assets play an important role in improving people's livelihood and helping them move out of poverty (McKay 2009). It enhances income generation activities. For example, in the case of the informal sector, ownership of durable goods such as a sewing machine, stove or refrigerator, may constitute business assets thereby enhancing income-generating activities (Deere *et al*. 2012). Individuals residing in a household which does not own at least two of the following: refrigerator/freezer, electric/gas stove, microwave, air conditioner, washing machine, sewing machine, grinding machine and wheelbarrow are considered deprived.

The third deprivation indicator (*transport*) assess household transport deprivation measured in terms of possession of automobiles or other transportation assets. Lack of transport impacts negatively on other social issues such as access to health or education in cases where the facilities are far (Allendorf 2007). Transport enhances one's ability to participate in social life (Rippin 2016). Longer times taken to travel also impacts negatively on people's opportunity for income-generating activities. Individuals residing in a household that does not own at least one of the following: van/truck/bakkie or car, tractor, donkey cart, bicycle and motorcycle are considered deprived.

[3] Age groups 0–4 and 5–17 have 20 indicators each while age groups 5–14 and 18 years and above have 19 indicators each. In total there are 24 indicators considered for the construction of the index.

The fourth indicator captures homeownership (*tenure*). In reference to the capability approach, homeownership is essential because it indicates a crucial functioning of 'security or protection' (Blank 2008; Doyal and Gough 1991). Housing ownership also reflects household income-generating opportunities in terms of generating rent, especially in urban areas. In Botswana, homeownership is understood beyond economic benefits and is an essential asset for families. It extends to social relations, as it confers status and prestige within one's community, and it enhances one's social participation (without shame). Individuals residing in a household which does not own the housing unit they live in are considered deprived.

2.2.2 Housing and living condition dimension

This dimension relates to material capabilities (Sen 1984) and directly captures capabilities of 'bodily health' and 'affiliation' (Nussbaum 2003). It captures deprivations relating to housing and living conditions (quality and overcrowding) and access to basic amenities, to capture the functioning of 'being well-sheltered'. People have the right to the basic shelter that enable them to live a dignified life (Nussbaum 1992). Adequate shelter is essential from the perspective of 'affiliation' capability (Nussbaum 2003).[4] The extent of shelter poverty in Botswana should be viewed in relation to the quality of housing structure using indicators such as the roof, floor, and wall material. The BPEPS emphasised shelter poverty (Republic of Botswana 2018). The National Housing Policy of 2000 aims to meet the shelter needs of the population and to provide decent and affordable housing for all within the context of a safe and sanitary environment.[5] The issue of housing is reflected in the SDG agenda. Target 11.2 aims to ensure adequate, safe, and affordable housing and basic services by 2030 (UN 2015). In line with the capability approach, I consider six deprivation indicators for this dimension: *overcrowding*, *cooking fuel*, *electricity*, *floor material*, *roof material* and *wall material*.

Overcrowding captures the living space per sleeping room measured by the number of household members per sleeping room. It is defined based on international standards of three persons per room, motivated by the UN-HABITAT criteria. Overcrowding is a good indicator of persistent poverty (Mushongara *et al*. 2017), and it affects individuals' well-being and does not positively contribute to a healthy environment (Espinoza-Delgado and Klasen 2018). Individuals living in overcrowded households often suffer from poor health conditions and educational outcomes (Leventhal and Newman 2010; Lund *et al*. 2011). Crowded living conditions increase the likelihood of contracting airborne diseases and respiratory infections (Graham 1990; Baker *et al*. 2000; Wanyeki *et al*. 2006) and can increase the risk of infant mortality (Cage and Foster 2002). This deprivation indicator takes into account household composition and children's age.[6] Individuals residing in a household with more than three persons per sleeping room are considered deprived.

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[4] Affiliation captures the capability of being able to have attachments to things and persons outside ourselves (Nussbaum 1992, 2000, 2003). Shelter is a key enabling factor because it does not only provide a place to stay, but also allows an interplay of essential functions, all operating in people's lives. It provides an opportunity for one to think, nurture relationships and friendships, play, relates with other species such as keeping pets, to enjoy life. All these 'are of central importance' to 'exist' and lead a 'good' life (Nussbaum 1992: 222).

[5] The policy intends to channel more resources to the provision of both rural and urban housing for low income groups. One of the main objectives of the National Housing Policy of 2000 is to promote housing as an instrument for economic empowerment and poverty alleviation. This has resulted in the introduction of the following programmes: The Destitute Housing programme, Remote Areas Housing Scheme, Presidential Housing Appeal Programme and Poverty Alleviation and Housing scheme.

[6] In Botswana it was agreed by key stakeholders during a workshop organised by BIDPA to decide on the MODA dimensions that children aged less than five should be given a weight of 0.5. Therefore, the indicator is calculated as: overcrowding = (number of children below five years*0.5 + number of household members aged five years and above*1)/number of rooms (de Neubourg *et al*. 2015). This was done to account for the housing standard condition in Botswana. Children especially infants do sleep with their parents in the same room. For example, a family of four made of a single mother and three children aged four, two and six months, respectively, sleeping in the same room is considered non-deprived using the threshold of three persons per room.

Cooking fuel indicator is also included for its intrinsic and instrumental significance (Klasen 2000), and it captures whether household members use dirty fuel that may cause high levels of air pollution or may be harmful to their health.[7] Evidence shows that indoor air pollution from dirty fuel has a significant impact on individuals' respiratory health (Duflo *et al*. 2008; Kaplan 2010), especially women who are responsible for cooking (Duflo *et al*. 2008). Individuals residing in households using the following source of fuel: biogas, wood, paraffin, cow-dung, coal, charcoal, and crop waste or having no source of fuel for cooking are considered deprived.

I use *electricity* to capture household connectivity to the Botswana Power Corporation (BPC) grid. Both the cooking fuel and electricity indicators are captured by SDG7 (target 7.1) which aims to ensure universal access to affordable, reliable, sustainable, and modern energy for all by 2030 (UN 2015). Individuals residing in a household not connected to BPC grid (not connected with electricity) are considered deprived.

The material used in the construction of the housing unit reflects the quality of housing. According to Krieger and Higgins (2002), there is a body of evidence associating housing quality with morbidity from infectious diseases, chronic illnesses, injuries, poor nutrition, and mental disorders. For example, asbestos used as wall material can cause mesothelioma and lung cancer (Landrigan 1998). Concerning floor material, old, dirty carpeting and mud floors are associated with dust, allergens, and toxic chemicals (Vaughan and Platts-Mills 200). People living in poor housing conditions are less likely to invite guests into their homes which may lead to social isolation (Krieger and Higgins 2002). The quality of housing directly affects the well-being of individuals (Klasen 2000).

I use three indicators to capture the quality of housing conditions: *floor*, *roof,* and *wall* material. Individuals residing in a shelter with the main material of the floor made of the following: mud, mud dung, brick/stones, or any other material apart from cement, floor tiles, or wood or has no flooring material are considered deprived. Concerning roof material, individuals residing in a housing unit with the main material of the roof made of the following: thatch/straw, asbestos, or any other material apart from slate, roof tiles, corrugated iron/zinc/tin, concrete are considered deprived. Lastly, concerning wall material, individuals residing in a housing unit with the main material of the wall made of the following: mud bricks/blocks, mud and poles/ cow dung/ thatch/ reeds, poles and reeds, corrugated iron/zinc/tin, asbestos, wood, stone and other/mixed materials are considered deprived.

2.2.3 Water and sanitation dimension

Like household and living condition, water and sanitation are also of considerable instrumental and intrinsic significance (Klasen 2000). The water and sanitation dimension is reflected in SDG 6 that calls to ensure availability and sustainable management of water and sanitation for all (UN 2015). These two indicators are linked to health. Lack of access to safe drinking water and adequate sanitation has a profound impact on individuals' health (UN 2003). For example, lack of access to clean drinking water and adequate sanitation is linked to higher morbidity and infant and child mortality (Trani and Cannings 2013). The United Nations General Assembly and the Human Rights Council recognise both access to water and sanitation as human right issues (UN 2010; UN and WHO 2010). Water and sanitation are publicly provided (public goods) and accessible equally within the household (Klasen and Lahoti 2016).

The indicator *water supply* seeks to capture individual deprivation in terms of both access to safe drinking water inside the household and the duration (time) to collect safe drinking water

[7] Dirty fuel includes use of firewood, paraffin, biogas, coal, charcoal, cow-dung and crop waste.

if it is fetched outside the yard, either from a public source or sourced from neighbours. According to the UN and WHO (2010), time taken to collect water should not exceed 30 minutes. This indicator captures both access and quality of water. Everyone has the right to water services that are physically accessible within, or near the household (UN 2010). Individuals residing in a household that uses unimproved water source including tanker, well, borehole, river/stream, dam/pan, rainwater, spring water, or if it takes at least 30 minutes to fetch water from a communal tap are considered deprived in this indicator.

I capture the sanitation deprivation indicator by *toilet facility*. Individuals residing in a household using unimproved toilet facility (pit latrine) or have no toilet facility are considered deprived. Those using the communal flush toilet, communal VIP, communal pit latrine or neighbours' toilet are also considered deprived.

2.2.4 Food security dimension

Deprivation in food is a good proxy for lacking the capability to avoid hunger or undernourishment (Sen 1992). The issue of hunger and food insecurity features prominently in the 2030 Agenda. It is reflected in SDG 2 (target 2.1) which states that 'By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round' (UN, 2015: 15). Food insecurity is a complex, multidimensional concept (Vaitla *et al*. 2017) and approaches to measure it needs to reflect this. The Food and Agriculture Organization (FAO) emphasises the multidimensionality of food security (FAO 2002).[8] There are four major dimensions of food security: food availability, food access, food stability and food utilisation (FAO 1996).

There is no single measure that adequately captures the complexity of food security (Maxwell 2014). Two different approaches (direct and indirect) measure food security (Sam *et al*. 2019).[9] In this study, I measure food insecurity based on two indicators: food access and food utilisation. These two are chosen based on data availability. The 2015/16 BMTHS do not have variables to capture food availability and food stability, hence their exclusion in deriving the food insecurity dimension.[10] Several approaches are employed to measure food access. These approaches include Coping Strategy Index (CSI); Reduced Coping Strategy Index (rCSI); Household Food Insecurity Access Scale (HFIAS); Household Hunger Scale (HHS); Food Consumption Score (FCS); Household Dietary Diversity Score (HDDS) and Self-assessed Measure of Food Security (SAFS) (Maxwell et *al*. 2013, 2014). The choice of each depends on the information available. I adopt the HFIAS methodology in developing the household food insecurity access indicator (Coates *et al*. 2007).[11] The HFIAS captures household behaviours signifying three domains of food insecurity; insufficient quality,

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8 The definition of food security states that, 'food security exists when all people, at all times, have physical, social and economic access to sufficient and nutritious food that meets their dietary needs and food preferences for an active and healthy life' (FAO 2002).

9 Some of the widely used indirect approaches include estimation of calories available per capita at national level used by FAO; household income and expenditure surveys; individual's dietary measures; anthropometry (Bashir and Schilizzi 2013).

10 Sam *et al.* (2019) defined food availability as the availability of sufficient quantities of food of appropriate quality, supplied through domestic production or imports. On the other hand, Shah and Dulal (2015) defined food in relation to ensuring enough food availability for those households that are at high risk of temporarily or permanently losing access to the resources needed to consume adequate food due to income shocks, lack of enough 'reserves' for adequate consumption, or both. Data for these two indicators is not captured by the 2015/16 BMTHS and are therefore excluded from the food insecurity dimension.

11 The HFIAS is one of the four experience-based food insecurity scales included in Data4Diets. The other three measures are the Household Hunger Scale (HHS) (Ballard *et al*. 2011; Deitchler *et al*. 2010), the Latin American and Caribbean Food Security Scale (ELCSA) (Ballard *et al*. 2013), and the Food Insecurity Experience Scale (FIES) (Ballard *et al*. 2013). The HFIAS provided the foundation for the development of these three measures.

insufficient quantity, as well as anxiety and uncertainty over household insecure access or food supply (Coates *et al*. 2007).[12]

I derive the *food access* indicator using information from Topical Module 7 of the 2015/16 BMTHS (self-assessed well-being and food insufficiency). The module comprised of nine questions that evaluate the food insecurity experienced in several grades of severity with a recall period of 30 days (SB 2018) used by Statistics Botswana adapted the questions from the HFIAS USAID FANTA project (Coates *et al*. 2007; Deitchler *et al*. 2011). The information obtained from HFIAS assesses the prevalence of household food insecurity (access) (Coates *et al*. 2007) which is useful for geographic targeting (Ballard *et al.* 2013, Coates *et al*. 2006) and to assess changes in the household food insecurity situation over time (Coates *et al*. 2007; Deitchler *et al*. 2011).

The questions ask people (household heads) directly about having to compromise on the quality and quantity of food they eat due to limited money or other resources to obtain food (SB 2018). Based on these nine questions, I create two main indicators: The Household Food Insecurity Access Scale Score (HFIASS) and the Household Food Insecurity Access Prevalence (HFIAP).[13] The HFIASS is a continuous measure of the degree of food (access) insecurity, ranging from zero to 27; the higher the score, the greater the food (access) insecurity experienced by the household members. On the other hand, the HFIAP categorises households into four levels of household food insecurity: food secure, and mildly, moderately and severely food insecure (Coates *et al*. 2007).[14] An individual is defined as deprived in terms of food access if he/she resides in a household that is either moderately or severely food insecure based on HFIAP. It would have been ideal to have data on food security at the individual level to capture the unequal distribution of resources within the household (Pinilla-Roncancio *et al*. 2019). However, information on household food security access is only available at the household level.

The second indicator is *nutrition* and goes beyond the '*access*' indicator and captures food utilisation.[15] This indicator captures the functioning of 'being well-nourished'. It is derived using anthropometric measure; child undernourishment based on WHO methodology (Alkire and Santos 2014; WHO 2006). This indicator determines the nutritional status of an individual (FAO 1996), and it indicates a functioning failure associated with life-long effects in terms of cognitive and physical development in the case of children (Alkire and Santos

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12 The HFIAS evaluates food insecurity severity using nine generic occurrence questions and nine follow-up frequency occurrence questions to determine how often the condition occurred. If the response is a 'no' for the generic occurrence question, then the follow-up frequency of occurrence questions is skipped. These questions represent three domains of the household food insecurity access: (1) anxiety and uncertainty about the household food supply, captured by the first question; (2) insufficient quality, relating to variety and preferences of the type of food, is captured by questions two to four; as well as (3) insufficient quantity of food intake and its physical consequences captured by questions five to nine (Coates *et al*. 2007; Deitchler *et al*. 2010).

13 A total of four HFIAS indicators can be computed. The other two are household food insecurity access-related conditions and household food insecurity access-related domains.

14 The algorithm used to compute household food insecurity access prevalence categories is based on Coates *et al.* (2007). (1) *food secure*: if a household experiences none of the conditions, or just experiences worry, but rarely is considered food secure; (2) *mildly food insecure*: if a household worries about not having enough food sometimes or often, and/or is unable to eat preferred foods, and/or eats a more monotonous diet than desired and/or some foods considered undesirable, but only rarely. But it does not cut back on quantity nor experience any of three most severe conditions is considered mildly food insecure. (3) *moderately food insecure*: if a household sacrifices quality more frequently, by eating a monotonous diet or undesirable foods sometimes or often, and/or has started to cut back on quantity by reducing the size of meals or number of meals, rarely or sometimes is considered moderately food insecure. (4) *severely food insecure*: if a household is cutting back on meal size or number of meals often, and/or experiences any of the three most severe conditions (running out of food, going to bed hungry, or going a whole day and night without eating), even as infrequently as rarely. In other words, any household that experiences one of these three conditions even once in the last four weeks (30 days) is considered severely food insecure (Coates *et al*. 2007: 19–20).

15 According to Timmer (2000) food utilisation consists of sufficient diet, clean water, sanitation, and health care to reach a state of nutritional well-being. It is the way the body makes the most of various nutrients in the body (Swindale and Bilinski 2006).

2014). It captures the capability to be free from hunger and to avoid undernourishment (Drèze and Sen 1989). The *nutrition* indicator is derived using children's information from the Anthropometric measurements' topical module. Ideally, it is desirable to include information on nutritional status for everyone. However, information on this indicator is available only for children. Due to the unavailability of data, I exclude adults in this indicator. According to this indicator, a child aged 0-4 is considered deprived in any of the three nutrition indicators (weight-for-age or height-for-age or weight-for-height) if his/her *z*-score is below minus two standard deviations from the median of the reference population. For children aged 5-17, a child is considered deprived in nutrition if his/her BMI z-score is below minus two standard deviation from the median of the reference population (Alkire and Santos 2014; WHO 2006).[16]

2.2.5 Health dimension

Health is considered a central capability (Nussbaum 2003; Sen 2000) and is one of the critical dimensions of well-being (Stiglitz *et al*. 2009). It has intrinsic as well as instrumental value (Alkire and Santos 2014; Klasen 2000). Being unhealthy can limit an individual's capability to take part in social activities, negatively influences his/her emotions and may prevent him/her from participating in active employment (Rippin 2016). The health dimension captures deprivations related to access and quality of the nearest health facility and chronic illness. The health dimension is reflected in SDG 3 (target 3.8) which aims to achieve universal health coverage, including financial risk protection, access to quality essential health care services and access to safe, effective, quality and affordable essential medicines and vaccines for all (UN 2005). Vision 2036 and NDP 11 both reiterates Botswana's long-standing recognition of the importance of the health status of its population. Vision 2036 recognises good health and wellness as fundamental human rights and necessary conditions for development (Republic of Botswana 2016). NDP 11 calls for the critical appraisal of the quality of health services to improve health outcomes (MFED 2017).

The first indicator is *the condition of the nearest health facility* capturing the perceived quality of the nearest health facility and problems associated with the health facility. Individuals are considered deprived if the perceived quality of the nearest health facility they use is poor or fair and has the following problems. In essence, the facility; is too far, is not clean or in poor condition, has few trained professional staff, has staff frequently absent, has lack of drugs, does not offer all services, and has limited opening hours.

The second indicator is a *chronic illness* and captures the capability of being healthy. Chronic illness is a significant public health and social welfare issue (Salway *et al*. 2007). Prolonged chronic illness can utterly impoverish people (Chambers 1983) and can lead to loss of income (due to inability to work) and asset depletion (Kyegombi 2003). People with chronic illness are often restricted in what they can do (inability to do any kind of work) (Beatty and Fothergill 2005). Individuals suffering from a chronic illness which prevents them from working, being active or going to school are considered deprived in this indicator.[17]

2.2.6 Education dimension

Education, like health, has intrinsic and instrumental value (Klasen 2000). It captures human capital and is vital for enhancing capabilities (Saito, 2003), and to be educated is a valuable achievement (Espinoza-Delgado and Klasen 2018). Education enhances one's well-being such as the likelihood of employment, future income, self-confidence and the ability to social

[16] The algorithm provided by WHO Child Growth Standards was used to estimate the *z*-scores of weight-for-age. BMI is computed as: BMI=weight/(height/100)^2.

[17] Some of the chronic illnesses listed by Statistics Botswana include among others; HIV/AIDS, tuberculosis, anaemia, cancer, malaria (SB 2018) which coincides directly with SDG 3 (target 3.3) which aims to end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water borne diseases and other communicable diseases by 2030 (UN 2015).

interaction (Rippin 2016). Therefore, not being educated constitutes a capability deprivation (Sen 2000). Nussbaum (2003) captured education dimension in her list of capabilities (senses, imagination, and thoughts), Narayan *et al*. (2000), Stiglitz *et al*. (2009) and the global MPI (Alkire and Santos 2014).

Education plays a vital role in the achievement of Botswana's national development aspirations and priorities, including the SDGs. The country recognises the importance and contribution of education to other development goals such as those focused on inequality reduction, gender inequality, poverty eradication, employment, and economic growth amongst others. According to Vision 2036, Botswana aspires to have an enlightened society with the relevant quality education that is outcome-based (Republic of Botswana 2016). NDP 11 emphasises access to quality education, starting from early childhood learning to tertiary education (MFED 2017). In the SDGs, education has a stand-alone goal, SDG 4, which calls for ensuring inclusive and equitable quality education and promote lifelong learning opportunities for all. Specifically, target 4.1 states that 'By 2030, ensure that all boys and girls complete free, equitable and quality primary and secondary education leading to relevant and effective learning outcomes' (UN 2015: 15). I capture the education dimension using three deprivation indicators.[18]

The first indicator refers to *child enrolment* and captures children in school-going age's exposure to the learning environment (enrolled in school). In Botswana, child enrolment is mandatory at six years, and include ten years of basic free education. The ten years include seven years of primary (six to 12 years), three years of junior secondary (13 to 15 years). Two years of senior secondary (16 to 17 years) forms part of 12 years of basic education before a child enrols for tertiary. Therefore, any child in the schooling going age 5-17, who is currently not enrolled, is considered deprived. The second indicator, *school attainment*, captures years of education attained by adults aged 18 and above. Any adult who has attained less than nine years of schooling is considered deprived in school attainment.[19] The third indicator is *literacy,* and it captures individuals' ability to read and write. Any individual aged 15 years and above and cannot read and write is considered deprived in terms of literacy.

2.2.7 Security dimension

This dimension captures the capability of "being able to move freely from place to place" (Nussbaum 2005). That is, to live a safe life free from crime and violence. Feeling unsafe diminishes numerous valuable capabilities (Nussbaum 2005). This dimension is directly linked to the capability of 'bodily integrity' (see Nussbaum 2000, 2003). In the SDGs, this dimension is reflected in SDG 16, target 16.1, which aims to significantly reduce all forms of violence and related deaths rates everywhere (UN 2015). I measure this dimension using two indicators (*safety* and *crime*).

The *safety* indicator is a subjective measure and assesses the perceived safety of the household from crime and violence. Individuals residing in a household whose head reported that they are feeling unsafe from crime and violence are considered deprived. The second indicator, *crime,* is an objective measure of security and ascertains whether individuals have been victims of violence or crime in the past 12 months. Any individual residing in a household with at least a member who has been involved violence is considered deprived. These indicators are identified at household-level due to unavailability of information at individual-level.

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[18] The four deprivation indicators are captured by targets 4.1, 4.2 and 4.6 in the 2030 SDG agenda document.

[19] A threshold of nine years corresponds with the number of years of basic education. The basic education was initially nine years before it was changed to ten years. I used the threshold of nine years since most adults went through the nine years basic education. I constructed years of schooling using highest educational level achieved and the highest grade obtained in that level.

Table 2.2 List of proposed dimensions and deprivation indicators†

Dimension	Indicator	Indicator definition	Deprivation cut-off (an individual is deprived if…)	Level	Group
1. Asset	Information	Captures lack of access to information and communication by household members	he/she resides in a household which does not own at least one of the following: TV, radio, PC/laptop, telephone (landline), mobile.	HH	All
	Durable goods	Captures the lack of durable assets used within the house	he/she resides in a household which does not own at least two of the following: refrigerator, washing machine, electric/gas stove, microwave, air conditioner, wheelbarrow, sewing machine, grinding machine.	HH	All
	Transport	Captures lack of ownership of automobiles (van/bakkie/truck or car)	he/she resides in a household which does not own any automobile including van/bakkie/truck, car, tractor, donkey cart, motorcycle, bicycle	HH	All
	Land tenure	Captures land ownership or possession of land and housing in which the housing unit is built.	he/she resides in a household which does not own the land in which the housing unit is built.	HH	All
2. Housing and living condition	Overcrowding	Captures the shortage of living space based on the number of rooms and persons in the household	he/she resides in a household with more than three people per sleeping room (excluding the kitchen, bathroom, and garage).	HH	All
	Cooking fuel	Captures the source of fuel for cooking used by households	he/she resides in a household which uses the following source of fuel: Biogas, wood, paraffin, cow-dung, coal, charcoal, and crop waste OR has no source of cooking fuel at all.	HH	All
	Floor material	Assesses the quality of the main material of the floor	he/she resides in a housing unit with the main material of floor made of the following: mud, mud dung, brick/stones, none, or any other material apart from cement, floor tiles, or wood.	HH	All
	Roof material	Assesses the quality of the main material of the roof	he/she resides in a housing unit with the main material of the roof is made of the following: thatch/straw, asbestos, or any other material apart from slate, roof tiles, corrugated iron/zinc/tin, concrete.	HH	All
	Wall material	Assesses the quality of the main material of the outside wall.	he/she resides in a housing unit with the main material of the outside wall is made of the following: mud bricks/blocks, mud and poles/ cow dung/ thatch/ reeds, poles and reeds, corrugated iron/zinc/tin, asbestos, wood, stone, other/mixed materials.	HH	All
	Electricity	Assess household connectivity to the national grid	he/she resides in a household which is not connected to the BPC grid.	HH	All

(Cont'd.)

Table 2.2 (Cont'd.)

Dimension	Indicator	Indicator definition	Deprivation cut-off (an individual is deprived if…)	Level	Group
3. Water and sanitation	Water supply	Assesses lack of access to safe drinking water source	he/she resides in a household which uses unimproved water source: bowser/tanker, well, borehole, river/stream, dam/pan, rainwater, spring water, OR if it takes at least 30 minutes to fetch water from a communal tap.	HH	All
	Toilet facility	Measures lack of access to basic and safe sanitation facility in the household	he/she resides in a household which uses an unimproved toilet facility: pit latrine, communal flush toilet, communal VIP, communal pit latrine, communal neighbours' toilet OR has no toilet facility at all.	HH	All
4. Food security	Food insecurity access (HFIAP)	Assesses household's lack of access to sufficient quantity and quality food.	he/she resides in a household which is categorised as moderately food insecure or severely food insecure based on HFIAP measure.	HH	All
	Weight-for-age (WAZ)	Assesses children's nutrition status.	he/she is a child who is malnourished. That is if his/her *z*-score of weight-for-age is below minus two standard deviation from the median of the reference population.	IND	0-4 years
	Height-for-height (HAZ)	Assesses children's chronic nutrition status (stunting)	he/she is a child who is stunted. That is if his/her *z*-score of height-for-age is below minus two standard deviation from the median of the reference population.	IND	0-4 years
	Weight-for-height (WHZ)	Assesses children's nutrition status in terms of wasting.	he/she is a child who is wasted. That is if his/her *z*-score of weight-for-height is below minus two standard deviation from the median of the reference population.	IND	0-4 years
	Body Mass Index (BMI)	Assesses children's nutrition status based on BMI.	he/she is a child aged between five and 17 with a BMI z-score below minus two standard deviation from the median of the reference population.	IND	5-17 years
5. Health	Health facility	Assesses the perceived quality of the nearest health facility.	the perceived quality of nearest health facility he/she uses is poor and has the following problems: the facility is too far, the facility is not clean or in poor condition, few trained professional staff, staff frequently absent, lack of drugs, does not offer all services, limited opening hours.	IND	All
	Chronic illness	Assess individuals' health status.	he/she has a long-term chronic illness that prevents them from working, being active or going to school.	IND	All

(Cont'd.)

Table 2.1 (Cont'd.)

Dimension	Indicator	Indicator Definition	Deprivation cut-off (an individual is deprived if …)	Level	Group
6. Education	Child school attendance	Quantifies the enrolment of individuals in the education system	he/she is a child aged 6–17 and is currently not enrolled in school.	IND	5-17 years
	Schooling achievement	Measures the number of years schooling	he/she is an adult aged 18 and above and has less than nine years of education.	IND	Above 18 years
	Literacy	Measures the ability of an individual to read and write	he/she is an adult aged 15 years and above, and he/she can't read and write	IND	Above 15 years
7. Security	Safety	Assess the perceived safety of household from crime and violence	he/she feels not safe from crime and violence.	HH	All
	Crime	Ascertains whether the member of the household has been a victim of violence or crime in the past 12 months.	he/she resides in a household which has at least one member who has been a victim of violence or crime in the past 12 months	HH	All

Source: Author's own. †HH stands for household, IND stands for the individual, Y indicates data availability for the indicator and N indicates data unavailability. Level means the identification level.

2.3 Weighting of dimensions

The next crucial step in the construction of a multidimensional measure (after selecting the dimensions, deprivation indicators and their respective cut-offs) is the choice of weights for dimensions and indicators (Alkire *et al*. 2015b). However, this has proven to be a challenging exercise (Decancq and Lugo 2013), since there is no specific procedure for setting weights in a multidimensional measure of poverty (Angulo *et al*. 2016). Different approaches exist in the literature, and these include normative judgements, reliance on empirical studies, participatory process, expert opinions, or inferential analyses using survey data (Decancq and Lugo 2013; Alkire and Santos 2014). Decancq and Lugo (2013) classified these different weighting schemes into three main categories: *normative, data-driven* and *hybrid*.[20]

In this paper, the final choice of weights is based on a normative approach and uses *equal weighting scheme* across dimensions. *Equal weighting* is the most common and widely used approach for weighting in multidimensional poverty measurements (e.g. Alkire and Foster 2011a, 2011b; Alkire and Santos 2014; Alkire *et al*. 2015b; Angulo *et al*. 2016; Ervin *et al*. 2018). The use of this approach is mainly due to its simplicity or from the recognition that all indicators are equally important since they are roughly equal in intrinsic value (Alkire and Santos 2014). Each dimension used in this study reflects their equal importance as constituents of quality of life and are considered equal in intrinsic value. The LNOB principle is premised on the human rights approach, and rights are deemed to be equally important.

Advantages of this weighting scheme include that its use eases the interpretation of the index for policy (Atkinson *et al*. 2002; Alkire and Santos 2014), that it is more transparent and that it allows comparisons over time (Battiston *et al*. 2013). Therefore, this study adopts equally weighting scheme across dimensions and equal nested weights within dimensions for each of the indicators (Alkire and Santos 2014; Angulo *et al*. 2016; Ervin *et al*. 2018). However, actual weights per indicator will differ across age groups as the total number of indicators differs across age groups (as a result of using the individual as a unit of analysis).

2.4 Aggregation

Several approaches for the aggregation have been proposed and applied in the empirical literature on multidimensional poverty measurement. These approaches include axiomatic approaches (Tsui 2002; Bourguignon and Chakravarty 2003; Alkire and Foster 2011a, 2011b; Chakravarty and D'Ambrosio 2013), statistical approaches including factor analysis (Lelli 2001), principal component analysis (Klasen 2000), multiple correspondence analysis (Kuklys 2005; Krishnakumar 2008), fuzzy set approach (Ceroli and Zani 1990; Cheli and Lemmi 1995; Belhadji and Lemam 2012; Betti *et al*. 2015) and dominance approach (Duclos 2006).[21] This study employs the counting methodology developed by Alkire and Foster (2011a) (henceforth AF) to estimate individual-level multidimensional poverty [22] and the inequality measure (I_q) proposed by Alkire and Seth (2014a).[23]

2.4.1 The AF methodology

The AF methodology was chosen over other methods because it is simple, flexible, and clear (Silber 2011; Thorbecke 2011) and extensively used in the empirical literature. This approach also satisfies a number of desirable properties and explicitly assesses the simultaneous or joint deprivations experienced by the poor people in a set of indicators (Alkire and Foster 2011a).

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20 For a detailed discussion of these three approaches see Decancq and Lugo (2013).

21 For a detailed discussion of these different approaches see Alkire *et al*. (2015b).

22 For a detailed outline of the methodology see Alkire *et al*. (2015b). Chapter five of the book discusses the methodology in detail.

23 This is referred to as 'triple I' of poverty (Incidence, intensity and inequality) (Sen 1976; Hanandita and Tampubolon 2016; Espinoza-Delgado and Klasen 2018).

Before describing the identification and the aggregation steps of the AF methodology, I consider the achievements of all n persons within a society in all d indicators, summarised by an n × d-dimensional matrix $\mathbf{X} = [x_{ij}]$, where x_{ij} is a set of achievement indicators for person i $(i = 1, \cdots, n)$ in indicator j $(j = 1, \cdots, d)$. Thus, row i of **X** represents the achievement vector of person i, summarising the person's achievements in all d indicators, and its jth column contains the achievements of all n persons in indicator j. The AF methodology uses a two-step 'dual cut-off' process to identify the poor (Alkire and Foster 2011b).

The first cut-off process is linked to deprivation cut-offs for each indicator, x_i and is denoted by z_i represented by a vector $z = (z_1, z_2 \cdots, z_d)$, where d represents the number of indicators. Any person i is deprived in any indicator j if her achievement falls below the deprivation cut-off z_j (or $x_{ij} < z_j$) for indicator j. From the **X** matrix and z vector, a matrix of deprivation $g^0[g_{ij}^0]$ is obtained such that $g_{ij}^0 = 1$ if $x_{ij} < z_j$ and $g_{ij}^0 = 0$ if $x_{ij} > z_j$ for all $j = 1, \cdots, d$ and $i = 1, \cdots, n$. Next, let $w = (w_1, w_2 \cdots, w_d)$ be the vector of indicators' weights. The weight attached to indicator j is denoted by w_j such that ($w_j > 0$). These weights sum to 1, that is, $\sum_{j=1}^{d} w_j = 1$ and $w_j \in [0,1]$. Then, the deprivation score c_i is computed for each person i, such that $c_i = \sum_{j=1}^{d} w_j g_{ij}^0$. If an individual is not deprived in any indicator $c_i = 0$ and if an individual is deprived in all indicators $c_i = 1$. The vector of deprivations for all individuals is given by $c = (c_1, c_2 \cdots, c_n)$.

The second step involves choosing poverty cut-off point, k, using the deprivation profiles in all indicators to identify the multidimensionally poor.[24] The choice of k is such that $1 \leq k \leq d$.[25] The poverty cut-off is implemented by using the method of identification ρ_k. A person i is identified as multidimensionally poor using a poverty cut-off k, such that if $c_i \geq k$. Algebraically, $\rho_k(x_i; z) = 1$ if $c_i \geq k$, and $\rho_k(x_i; z) = 0$ otherwise. Following Alkire and Santos (2014), this study uses a cut-off of 33.33 per cent (k = 0.3333). From the deprivation matrix $g^0[g_{ij}^0]$, a censored deprivation matrix $g^0(k)$ is constructed by multiplying each element in g^0 by the identification function $\rho_k(x_i; z): g_{ij}^0(k) = \rho_k(x_i; z): g_{ij}^0 \times \rho_k(x_i; z)$ for all i and for all j. A censored deprivation score vector for all individuals is then obtained from the original deprivation score vector: $c(k) = c \times \rho_k(x_i; z)$. Let $c(k) = \sum_{j=1}^{d} w_j g_{ij}^0(k)$ be the censored deprivation score of individual i; by definition $c_i(k) = c_i$, if $c_i \geq k$ and $c_i(k) = 0$, if $c_i < k$ (Alkire and Santos 2014).[26] Then, $c(k) = [c_1(k), c_2(k) \cdots, c_n(k)]$.

The AF methodology proposes a family of multidimensional poverty measures Mα that is based on the FGT class of poverty measures (Foster *et al*. 1984) to solve the problem of aggregation. This study uses the first measure of this family; the adjusted headcount ratio is denoted by M_0 and contains both multidimensional headcount ratio (incidence of poverty), H and the average deprivation scores, capturing the intensity of poverty, A (Alkire *et al*. 2015b). Algebraically, M_0 is computed as:

$$M_0 = H \times A = \frac{q}{n} \times \frac{1}{q} \sum_{i=1}^{q} c_i(k) = \frac{1}{n} \sum_{i=1}^{n} c_i(k) \qquad (1)$$

[24] The choice of k can be made normatively, either based on previous studies or what the society would consider reasonable. It can also be chosen to reflect the country's policy goal (Mushongera *et al*. 2017).

[25] k represents the share of weighted deprivations that a person must experience to be considered multidimensionally poor. That is, in order to be identified as multidimensionally poor, a person's deprivation score must be equal to or larger than the poverty cut-off ($c_i \geq k$).

[26] The censoring step retains the deprivation scores of those who are identified as poor and replaces the deprivation scores of those who are not identified as poor ($c_i < k$) by 0 (Alkire *et al*. 2015b).

This study uses M_0 to estimate individual-level multidimensional poverty in Botswana. The advantages of this measure are based its two key properties: the 'population subgroup decomposability' which allows for examining subgroup contributions to all poverty, and the breakdown property by indicator which makes it possible to find out the contribution of each indicator to the overall poverty.

2.4.2 The Inequality methodology

Further, and in line with LNOB, this study examines inequality among the multidimensionally poor. The study employs a separate inequality measure (I_q) proposed by Alkire and Seth (2014a). This proposed measure is decomposable and is based on positive-multiple variance to overcome the obstacles stemming mainly from the use of non-cardinal indicator variables in the construction of M_0. (Alkire and Seth 2014a; Hanandita and Tampubolon 2016). The inequality among the poor is computed as:

$$I_q = \frac{\tilde{\beta}}{q}\sum_{i=1}^{q}[c_i(k) - A]^2 \qquad (2)$$

where q denotes the number of the multidimensionally poor and $\tilde{\beta}$ is the normalisation factor that must be chosen such that $I_q = [0,1]$ (Alkire and Seth 2014a), representing the properties of any standard inequality (Hanandita and Tampubolon 2016). Following Alkire and Seth 2014a) $\tilde{\beta}$ equals the inverse of $\frac{1}{4}\{max[c_i(k)] - \min[c_i(k)]\}^2$.[27] Therefore, $\beta = 4$ in equation 2. This measure (I_q) helps to reveal pockets of high intensities that might otherwise be missed by poverty measures, thereby helping to ensure that no one is left behind (Alkire and Seth 2014b). In the SDGs, this is captured by SDG 10, which aims to reduce inequality within and among countries (UN 2015). Inequality is a problem of inclusion, and LNOB is a tool for addressing inequality (Fukuda-Parr and Hegstad 2018).

2.5 Association between deprivation indicators

Table 2.3 presents the Spearman rank correlation coefficients between the deprivation indicators. Overall, the results show that most deprivation indicators are weakly correlated. For example, the correlation between education indicators and other indicators is comparatively very low (exhibiting correlations below 0.30). Similarly, health deprivation indicators are weakly related to other indicators (less than 0.20). The same is observed for security deprivation indicators and nutrition deprivation indicators. Except for a moderate correlation between electricity and durable goods, all assets indicators are weakly related to other deprivation indicators. Housing and living condition indicators show mixed results with most indicators exhibiting weak correlations, except for electricity showing moderate correlation with durable goods and cooking fuel. Quality of housing condition indicators (roof, floor, and wall) are related, showing moderate to a strong association (exhibiting correlations between 0.655 and 0.75). Electricity shows a significant moderate and positive association with durable goods and cooking fuel. The generally weak correlation between deprivation indicators justifies for a more holistic approach to the measurement of multidimensional poverty (Espinoza-Delgado and Klasen 2018).

[27] That is, 'the maximum possible value that variance takes is one fourth of the range of the deprivation score vector, which is attained when half of the population have the lowest scores and the other half have the highest deprivation scores' (Alkire and Seth 2014a: 16).

Table 2.3 Spearman's rank correlation coefficients between deprivation indicators 2015/16†

	DG	TR	LD	OC	CF	FL	RF	WL	EL	WR	TF	FA	WZ	HZ	WH	BM	HF	CI	EN	LT	SC	SF	CR
IF	.382**	.236**	-.059**	.230**	.292**	.260**	.225**	.250**	.419**	.165**	.237**	.198**	.055**	.022**	.034**	.024**	.007**	-.009**	.083**	.120**	.108**	.015**	-.041**
DG	1	.402**	-.115**	.318**	.480**	.312**	.254**	.329**	.582**	.218**	.426**	.339**	.055**	.047**	.040**	.058**	.048**	.021**	.119**	.166**	.217**	.002*	-.041**
TR		1	-.069**	.295**	.386**	.195**	.160**	.195**	.353**	.107**	.421**	.336**	.075**	.096**	0.001	.069**	.071**	.025**	.084**	.135**	.180**	.006**	-.074**
LD			1	.038**	-.319**	-.108**	-.076**	-.097**	-.120**	-.014**	-.268**	-.189**	-.021**	-.048**	.041**	-.033**	-.085**	-.072**	-.024**	-.132**	-.241**	.023**	-.020**
OC				1	.286**	.281**	.234**	.274**	.374**	.132**	.343**	.240**	.083**	.090**	.030**	.043**	.025**	-.037**	.107**	.087**	.092**	.024**	-.056**
CF					1	.366**	.311**	.368**	.584**	.268**	.525**	.388**	.098**	.098**	.019**	.080**	.074**	.032**	.119**	.238**	.316**	-.006**	-.059**
FL						1	.693**	.750**	.459**	.417**	.250**	.180**	.030**	.018**	.005*	-.004**	-.008**	.004**	.145**	.208**	.195**	-.030**	-.040**
RF							1	.655**	.392**	.344**	.198**	.142**	.015**	.041**	-.022**	.012**	-.038**	0.001	.095**	.174**	.149**	-.020**	-.050**
WL								1	.470**	.394**	.243**	.194**	.030**	.029**	0.003	.011**	-.010**	.008**	.123**	.200**	.199**	-.030**	-.043**
EL									1	.350**	.461**	.327**	.077**	.082**	-0.002	.050**	.035**	.030**	.141**	.224**	.273**	.007**	-.081**
WR										1	.190**	.047**	.037**	-.006**	-0.001	-.011**	-.016**	.032**	.107**	.162**	.176**	.019**	-.024**
TF											1	.381**	.067**	.074**	0.003	.072**	.093**	.026**	.108**	.181**	.270**	-.002**	-.081**
FA												1	.045**	.060**	.022**	.077**	.130**	.041**	.077**	.145**	.207**	.028**	-.008**
WZ													1	.373**	.331**	.c	-.014**	.014**	.c	.c	.c	-.030**	-.010**
HZ														1	-.028**	.c	-.018**	.012**	.c	.c	.c	-.068**	-.040**
WH															1	.c	0.000	-.011**	.c	.c	.c	0.000	-.037**
BM																1	.020**	.009**	-.025**	-.035**	.c	-.009**	-.016**
HF																	1	.011**	-.007**	.006**	.030**	.075**	.006**
CI																		1	.007**	.134**	.290**	.021**	.011**
EN																			1	.203**	.c	0.000	.007**
LT																				1	.385**	-.011**	-.023**
SC																					1	.010**	-.030**
SF																						1	.196**

Source: Author's own, based on data from SB (2018). †Results are estimated at population-level using sample weights. ID: indicator; IF: information; DG: durable goods; TR: transport; LD: land tenure; OC: overcrowding; CF: cooking fuel; FL: floor; RF: roof; WL: wall; WR: water; TF: toilet facility; EN: enrolment; LT: literacy; SC: school attainment; HF: health facility; CI: chronic illness; FA: food access; WZ: weight-for-age; HZ: height-for-age; WH: weight-for-height; BM: body mass index; SF: safety; CR: crime. **, *Correlation is significant at the 0.01 and 0.05 level (2-tailed) (respectively). Sample size: 24,720. cNo data to compute correlations.

3 Results and discussions

In this section, I present the results of the multidimensional poverty index for Botswana. First, I present and discuss the descriptive results of the uncensored deprivation headcount ratios. Second, the aggregate multidimensional poverty index is presented, together with aggregate poverty incidence, intensity, and adjusted headcount ratio. Third, I include the inequality amongst the multidimensionally poor in line with LNOB principle.

3.1 Deprivation incidences by indicator

Before aggregating the results into a single index, there is a need to analyse each deprivation indicator. Therefore, in this section, I examine the overall deprivation rates for the whole population by each deprivation indicator. Table 3.1 presents 'the uncensored headcount ratio' (see Alkire and Santos 2014), that is the estimated proportion of individuals deprived in each of the twenty-four indicators used. Even though Botswana has done well in terms of reducing monetary poverty, this study finds a rather gloomy picture with respect to non-monetary deprivation indicators.

Generally, the results show that most Batswana are deprived in indicators relating to asset and housing and living condition dimensions. Concerning asset, 71.4 per cent of the population do not own any form of transport, and 56.2 per cent are deprived in durable goods. In terms of land, 37.5 per cent of Batswana have no land of their own, and 22.4 per cent have no access to information. In terms of housing and living condition, 47.5 per cent and 40.2 per cent of the population are deprived in terms of cooking fuel and living space (overcrowding) respectively. About 36.2 per cent of the population has no access to electricity and 10, 12.5 and 17.6 per cent are deprived in the roof, floor, and wall materials, respectively. A total of 64.7 per cent of the population is deprived in sanitation. That is, they lack access to a safe toilet facility, while 9.7 per cent of the population has no access to safe drinking water.

With respect to food security, about 49.2 per cent of the population indicated they do not have access to food. About 17.4 per cent, 7.6 per cent and 5.2 per cent of children aged 0-4 years are stunted, undernourished, and wasted respectively, while those aged 5-17 are deprived in terms of body mass index. With respect to education, about 41.7 per cent of adults are deprived in school attainment and about 10.7 per cent of children aged 5-17 years are not enrolled in school while 8.9 per cent of those aged 15 years and above are illiterate. Regarding health, about 33.8 per cent of the population is deprived in terms of access to a health facility and 17 per cent are chronically ill. In terms of security, about 39.7 per cent of Batswana indicated they feel unsafe, while 10 per cent reported they had been victims of crime and violence. These findings confirm the need to shift from monetary measure to multidimensional measure of poverty.

Table 3.1 Proportion of deprived population by indicator†

Dimension	Indicator	Sample	% Deprived	SD	Age group
1. Asset	Information	24,720	22.4	0.4167	All
	Durable goods	24,720	56.2	0.4962	All
	Transport	24,720	71.4	0.4521	All
	Land tenure	24,720	37.5	0.4840	All
2. Housing	Overcrowding	24,720	40.2	0.4903	All
	Cooking fuel	24,720	47.5	0.4994	All
	Floor material	24,720	12.5	0.3311	All
	Roof material	24,720	10.6	0.3073	All
	Wall material	24,720	17.6	0.3804	All
	Electricity	24,720	36.2	0.4807	All
3. Water and sanitation	Water supply	24,720	9.7	0.2959	All
	Toilet facility	24,720	64.7	0.4780	All
4. Food security	HFIAP	24,720	49.2	0.4999	All
	WAZ	3,104	7.6	0.2653	0-4
	HAZ	3,104	17.4	0.3789	0-4
	WHZ	3,104	5.2	0.2226	0-4
	BMI	6,614	10.7	0.3093	5-17
5. Health	Health facility	24,720	33.8	0.4730	All
	Chronic illness	24,720	17.0	0.3758	All
6. Education	School enrolment	6,614	10.5	0.3051	5-17
	Literacy	16,227	8.9	0.2853	15 and above
	School attainment	15,002	41.7	0.4931	18 and above
7. Security	Safety	9,718	39.7	0.4893	All
	Crime	9,718	10.4	0.3051	All

Source: Author's own, based on data from SB (2018). †All percentages are estimated at population-level using sample weights. SD stands for standard deviation. HFIAP: household food insecurity access prevalence; WAZ: weight-for-age; HAZ: height-for-age; WHZ: weight-for-height; BMI: body mass index. Sample size: 24,720.

In line with LNOB principle and SDG 1 (target 1.2), I discuss the deprivation incidences across all the indicators in all selected dimensions by different subgroups of the population. Figure 3.1 depicts the decomposition of deprivation indicators among various age groups and Tables A1–A3 (in the Annexe) presents the results across deprivation indicators by other demographic characteristics, economic and geographical variables. In general, the results reveal that there exist substantial differences in deprivation levels among deprivation indicators across different groups. Older persons are the worse off group exhibiting higher deprivation rates in most deprivation indicators than other age groups.

Asset dimension: Results show varying deprivation levels among asset indicators across different subgroups. With respect to gender, except for transport, males are worse off than females in all asset indicators (information, durable good and land tenure). The same is observed across disability status with persons with disability exhibiting higher deprivation levels. Except for land tenure, individuals from households headed by women are worse off compared to those from households headed by men in all asset indicators. Older persons

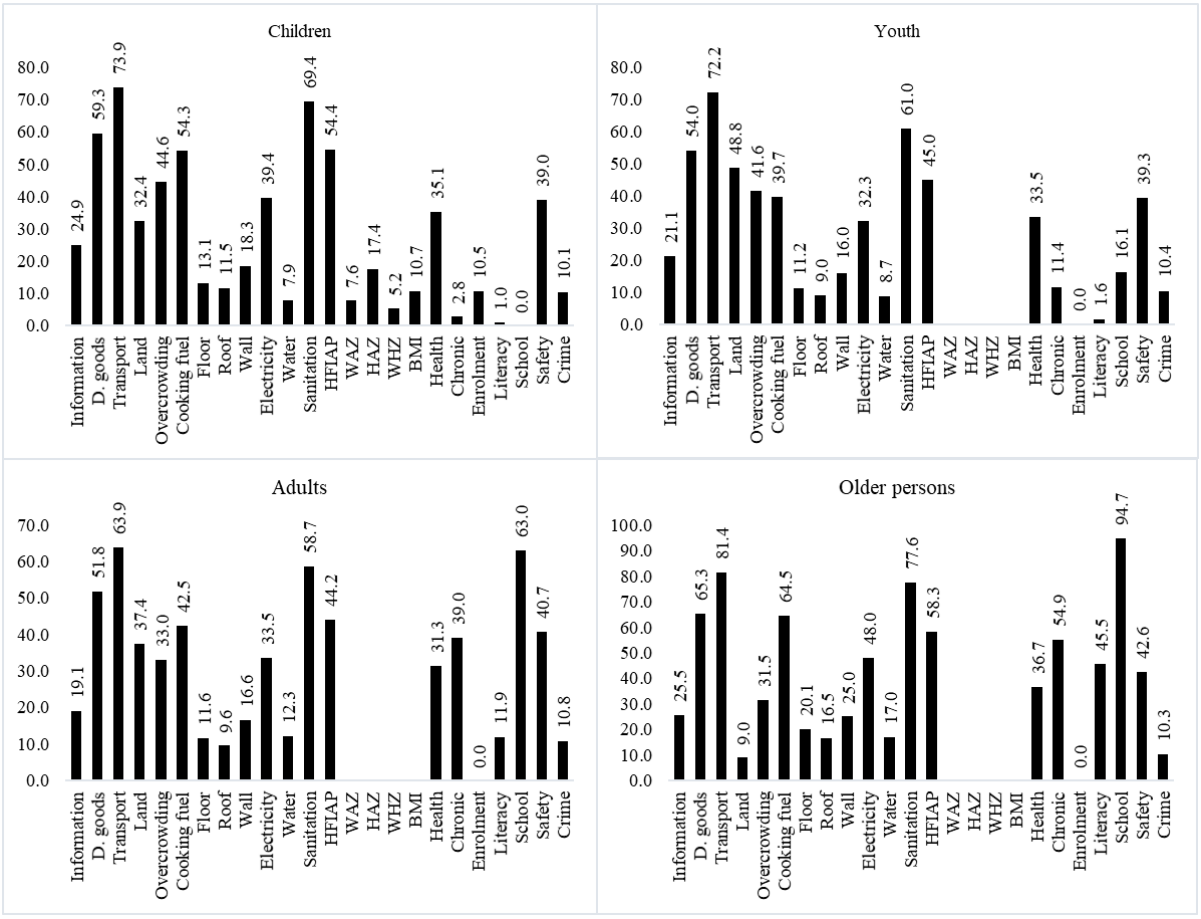
are worse off in all asset indicators than other age groups, except for land tenure (Figure 3.1). Individuals from households headed by children are worse off in all asset indicators.

Concerning marital status, individuals from households headed by married couples are better off in all asset indicators except for land tenure. Deprivation levels across all asset indicators decline with improvements in educational attainment except for land tenure. The same is observed along quintiles (Table A2). Employment status of the household head showed mixed results, with individuals from households whose heads are engaged in paid employment being better off in all asset indicators except for land tenure. Individuals from rural areas are worse off compared to those from urban villages and cities and towns in all asset indicators except for land tenure. Ngamiland West and Kweneng West are worse off in all asset indicators except for land tenure.

Housing and living conditions dimension: Males, non-citizens, and persons with disability (PWDs) are worse off in all housing and living condition indicators. Individuals residing in female-headed households are worse off in overcrowding and fuel for cooking. At the same time, those from male-headed households are worse off in construction material indicators (roof, wall, and floor material) (Table A1). Except for overcrowding, adults are worse off in all housing indicators (Figure 5.1). Individuals from households headed by married couples are better off in most of the housing indicators except for overcrowding and fuel for cooking. Individuals from households headed by children are worse off in all housing and living condition indicators. Deprivation levels in housing indicators decline with improvements in educational attainments.

Similarly, deprivation levels decline along quintiles with individuals from housing belonging to the bottom quintile (Q1) being worse off. Individuals from households whose heads are engaged in paid employment are better off compared to other groups. Those individuals from rural areas have higher deprivation levels in all housing indicators than those from urban villages and cities and towns. With respect to districts, Ngamiland West recorded the highest deprivation levels across all housing indicators ranging from 61 per cent to 92 per cent (Table A3).

Figure 3.1 Proportion of deprived population by age and indicator†



Source: Author's own, based on data from SB (2018). †All percentages are estimated at population-level using sample weights. SD stands for standard deviation. HFIAP: household food insecurity access prevalence; WAZ: weight-for-age; HAZ: height-for-age; WHZ: weight-for-height; BMI: body mass index. Sample size: 24,720.

Water and sanitation dimension: Males are worse off in both access to water and toilet facility. Citizens have higher deprivation rate in toilet facility than non-citizens, and the opposite is true for access to safe drinking water. Persons with disability are worse off in both access to safe drinking water and toilet facility than those with no disability. Individuals from households headed by children have higher deprivation levels in both access to water and toilet facility. Those individuals from female-headed households are worse off in terms of access to water while those from male-headed households are worse off regarding toilet facility. Individuals from households headed by married couples are better off in both access to safe drinking water and toilet facility. Both deprivation levels in access to water and toilet facility decline with improvements in educational attainments.

Similarly, deprivation levels decline along quintiles, with individuals from the bottom quintile experiencing higher deprivation in access to water and toilet facility. Individuals from rural areas have higher deprivation levels in both access to safe drinking water and toilet facility. With respect to administrative districts, Kweneng West is the deprived district in terms of access to safe drinking water. Both Kweneng West and Ngamiland District recorded deprivation levels of more than 92 per cent with respect to a toilet facility.

Food security dimension: Females are worse off in terms of food access than males. However, the opposite holds in terms of child nutrition indicators, where boys are worse off than girls. Except for wasting, citizens are worse off than non-citizens. The same result is observed for persons with disability compared to those with no disability. Similarly, individuals from female-headed households experience higher deprivations in all food

security indicators compared to males except for wasting. In terms of household headship, individuals from households headed by married couples are better off in all food security indicators.

Similarly, those from households whose heads attained higher educational achievements are better off. Except for stunting, those from households whose heads are unemployed are worse off in all food security indicators. Deprivation levels in all food security indicators decline along quintiles with the bottom quintile being worse off. Individuals from rural areas have higher deprivations in food security than those from urban villages and cities and towns. Kweneng West and Ngamiland West recorded the highest deprivation rates of more than 80 per cent with respect to deprivation in food access. Similarly, Kweneng West recorded the highest deprivation rates in stunting. Ghanzi district is worse off in terms of undernutrition and wasting.

Health: The results show that deprivation rates in health indicators (health access and chronic illness) are higher for females than males. The finding that females have higher deprivation levels in chronic illness is common in the literature (Case and Paxson 2005). Females are more likely to suffer from illness (Case and Deaton 2005). Older persons also experienced the highest deprivation rate estimated at over 50 per cent with respect to chronic illness (Figure 3.1). Individuals from female-headed households and those from households headed by older persons are worse off in all health indicators. Deprivation levels in health indicators decline with improvement in educational attainments and along quintiles. Individuals from households whose heads are engaged in formal employment are better off in health indicators than those from other households. Individuals from rural areas are worse off in both health access and chronic illness than those from urban villages and cities and towns. Chronic illness is more prevalent in Central Serowe Palapye district while deprivation in health access is worse off in Ngamiland West.

Education dimension: In terms of gender, results show that boys are worse off in terms of enrolments than girls while women are worse off in school attainment. Deprivation in education (school attainment and literacy) is more pronounced among older persons and adults, with school attainment exhibiting the highest levels for older persons (Figure 3.1). More than nine out of ten older persons have not attained basic education in Botswana. Persons with disability are worse off in all education indicators than those with no disability. For example, the deprivation rate in terms of school enrolment (attainment) is more than double for children with disability (adults), and the illiteracy rate is more than four times higher for persons with disability than those with no disability. This finding confirms evidence of higher exclusion from the education system for persons with disability in Botswana. Similar conclusions, especially in developing countries, exist in the literature (Trani and Loeb 2012). Exclusion from accessing education have negative impacts on the self-esteem and psychological well-being of persons with disability (Mollica *et al*. 1999).

Citizens are better off in all education indicators than non-citizens, and this is due to the free education system in Botswana. Except for enrolment indicator, individuals from female-headed households are worse off than those from male-headed households. Similarly, those from households headed by older persons are worse off except for enrolment. Marital status reveals mixed results with individuals from households headed by married couples exhibiting lower deprivation levels in enrolment while those from households whose heads are separated being better off in literacy and school attainment. Kweneng West and Ngamiland West are worse off in terms of school achievement. Kweneng West also recorded the highest levels of deprivation in school enrolment while Ngamiland West recorded the highest deprivation levels in literacy.

Security dimension: Females are worse off in terms of safety and crime than males. Similarly, persons with disability are worse off than those with no disability. Deprivation levels

are higher for citizens than non-citizens. Individuals from female-headed households experience higher deprivations in safety while those from male-headed households experience higher deprivations in crime. Similarly, those residing in households headed by children have higher deprivations in crime. With respect to marital status, the results are mixed with those from households headed by divorced persons being worse off in both safety and crime. Individuals from households belonging to the highest quintile (Q5) have higher deprivation rates in crime, while the results are mixed for safety indicator. Deprivation levels in safety and crime are higher for those individuals from households whose heads are engaged in self-employment and those working on their farms. Deprivation levels in safety and crime are higher in urban villages and cities and towns than in rural areas. Kweneng East recorded the highest deprivation levels in both safety and crime than all other districts.

In sum, the results show considerable variation in deprivations across indicators among different subgroups of the population. Persons with disability experience higher levels of deprivation across most of the deprivation indicators compared to those with no disability. Similarly, deprivation levels are higher for older persons compared to other age groups. As expected, deprivation levels are more pronounced in rural areas than in urban villages and cities/towns. Ngamiland West and Kweneng West are the most affected districts in terms of deprivations in most indicators.

3.2 Multidimensional poverty incidences and intensity

In this section, the results of multidimensional poverty incidences are reported and discussed. Table 3.2 presents the results of the estimates of multidimensional headcount ratio (H), the average deprivation share across the multidimensional poor (A), and the adjusted headcount ratio (M_0). The results reveal that 46.2 per cent of the population in Botswana can be considered to be multidimensionally poor. The results show that the incidence of multidimensional poverty in Botswana remains a substantial problem. Multidimensional poverty intensity is estimated at 47.4 per cent, meaning, on average, individuals are simultaneously deprived in at least 11 out of the 24 indicators considered. The adjusted headcount ratio is estimated at 0.219. I present detailed analysis and discussion of multidimensional poverty levels (incidence, intensity, and adjusted headcount ratio) by different subgroups of the population below.

3.2.1 Estimates by demographic characteristics

To identify the left behind, I disaggregate the analysis by different demographic characteristics. The results reveal that poverty levels are almost equal for males and females, with females slightly worse off than males. With respect to age, poverty levels vary significantly and increase with an increase in age. Older persons exhibit higher levels of multidimensional poverty compared to other age groups. This finding is consistent with other researchers who found that multidimensional poverty is higher for older persons than children (Espinoza-Delgado and Klasen 2018; Franco-Correa 2014). The poverty levels among older persons are mostly driven by deprivation in educational attainment. Older persons also suffer from chronic illness, preventing them from participating in the active labour market, including working on their farm. It is essential to note the substantially wider gap in poverty levels between persons with disability and those with no disability, with persons with disability exhibiting highest poverty levels. This finding is consistent with the recent literature that found multidimensional poverty to be higher for persons with disability (Mitra *et al*. 2012; Trani and Cannings 2013; Trani *et al*. 2013, 2016).

Table 3.2 Multidimensional poverty measures by demographic and economic variables 2015/16†

Subgroup	Population	(%)	H (%)	A (%)	M_0
Gender					
Female (ref)	1,097,366	52.9	46.8	47.6	0.223
Male	976,309	47.1	45.6***	47.1***	0.215***
Age					
0 to 17 years (children) (ref)	817,843	39.4	41.7	43.4	0.181
18 to 35 years (youth)	643,725	31.0	42.5***	46.7***	0.198***
36 to 64 years (adults)	501,325	24.2	51.8***	51.1***	0.264***
65+ (older persons)	110,781	5.3	76.6 ***	53.9***	0.413***
Disability status					
Persons with disability (PWD)	58,028	2.8	73.3***	53.8***	0.395***
No disability (ref)	2,015,647	97.2	45.5	47.1	0.214
Citizenship					
Citizen (ref)	2,005,908	96.7	47.2	47.4	0.224
Non-citizen	67,767	3.3	18.2***	46.4***	0.085***
Gender of HH					
Female-headed (ref)	1,070,945	51.6	49.7	46.7	0.232
Male-headed	1,002,730	48.4	42.6***	48.2***	0.205***
Age of HH					
12–17 (children)	4,109	0.20	58.1***	41.5***	0.241***
18–35 (youth)	462,535	22.3	40.9***	46.2***	0.189***
36–64 (adults) (ref)	1,202,243	58.0	43.3	47.1	0.204
65+ (older persons)	404,788	19.5	61.0***	48.8***	0.298***
Marital status of HH					
Married (ref)	643,176	31.0	32.6	46.5	0.151
Living together	513,572	24.8	53.8***	48.1	0.259***
Separated	41,454	2.0	52.5***	46.5	0.244***
Divorced	40,579	2.0	38.1***	47.4***	0.181***
Widowed/Widower	273,647	13.2	54.1***	47.8***	0.259***
Never married	561,248	27.1	51.2***	47.2***	0.242***
Household size					
1 to 3 members	630,661	30.4	41.8***	49.1***	0.205***
4 to 6 members (ref)	798,554	38.5	40.8	46.9	0.192
More than 7 members	644,460	31.1	57.3***	46.5***	0.267***
Educational attainment of HH					
None (ref)	573,172	27.6	67.9	49.9	0.339
Primary	530,910	25.6	54.8***	46.9***	0.257***
Secondary	594,822	28.7	39.6***	44.5***	0.176***
Vocational	70,540	3.4	22.2***	42.4	0.094***
University	304,231	14.7	9.1***	44.3***	0.040***
Total	**2,073,675**	**100**	**46.2**	**47.4**	**0.219**

Source: Author's own, based on data from SB (2018). HH stands for the household head.
†All percentages are estimated at population-level using sample weights. Sample size: 24,720.
Significance levels: *p <0.1; **p <0.05; ***p <0.01.

Individuals residing in a household headed by men are slightly better off than those in a household headed by women. Similar studies in developing countries confirm this finding (Fransman and Yu 2019; Trani *et al*. 2016). However, those from male-headed households have higher poverty intensity than those from female-headed households. As expected, individuals residing in a household headed by older persons and children experience a higher incidence of poverty than those living in other households. Most households headed by children include orphans, and the living conditions in such households are worse forcing children not to attend school, resulting in higher multidimensional poverty levels. However, the intensity of poverty declines with an increase in age of household head. These households comprised of larger families, mostly dependents (children and older persons). Poverty levels exhibit a U-shaped relationship with household size. That is, individuals residing in smaller families experience higher levels of poverty and the trend declines with households with four to six members after which it increases for households with more than seven members. With respect to marital status, individuals from households headed by married couples experience lower levels of poverty than those from households headed by unmarried persons. As expected, poverty levels decline with higher levels of educational achievements.

3.2.2 Estimates by economic variables

It is interesting to examine how multidimensional poverty levels vary across income groups (Table 3.3). I used per capita consumption as a proxy for income. The results reveal a wide disparity in poverty levels. Individuals from a household in the poorest households (bottom quintile) exhibited the highest levels of multidimensional poverty. For example, the incidence of poverty for individuals from the poorest households is almost six times higher than that of individuals from the wealthiest quintile. This finding is consistent with other studies (Fransman and Yu 2019; Mushongera *et al*. 2017; Roelen 2017).

With respect to the employment status of the household head, the results reveal mixed and surprising findings. Poverty levels are more pronounced among individuals from households headed by family helpers (domestic workers) or engaged in subsistence agriculture than those from households headed by unemployed persons. The majority have lower educational attainments, resulting in low wages. As expected, individuals from households whose heads are engaged in formal paid employment exhibited lower levels of poverty.

Table 3.3 Multidimensional poverty measures by economic variables 2015/16†

Economic variables	Population	(%)	H (%)	A (%)	M_0
Employment status of HH					
Unemployed (ref)	910,301	43.9	59.6	47.7	0.284
Paid employment	667,766	32.2	26.1***	44.6***	0.116***
Self-employment	225,456	10.9	29.7***	44.6***	0.132***
Own farm	141,822	6.8	59.8***	50.6***	0.303***
Family helper	128,329	6.2	70.1***	49.8***	0.350***
Quintiles					
Q1 (ref)	726,785	35.1	68.3	48.1	0.329
Q2	461,592	22.3	51.3***	46.9***	0.241***
Q3	351,832	17.0	36.2***	46.3***	0.168***
Q4	281,835	13.6	23.8***	46.3***	0.110***
Q5	249,105	12.0	11.6***	44.8***	0.052***
Total	**2,073,675**	**100**	**46.2**	**47.4**	**0.219**

Source: Author's own, based on data from SB (2018). †All percentages are estimated at population-level using sample weights. Sample size: 24,720. Per capita quintiles were calculated at household-level. Per capita quintiles are defined as follows. Q1: y≤371.75; Q2: 371.76 ≤y≤ 665.32; Q3: 665.33.53≤ y≤1172.82; Q4: 1172.83≤y≤2238.13; y≥2238.14. HH stands for the household head. Significance levels: *p <0.1; **p <0.05; ***p <0.01.

3.2.3 Estimates by geographic variables

To identify where those who are multidimensionally poor live, I analyse the results by geographical location. Table 3.4 presents poverty levels by geographical variables. The results reveal that multidimensional poverty levels are more pronounced in rural areas than in urban villages and cities/towns. Both poverty incidences and adjusted headcount ratio are more than three times in rural areas than in cities/towns. This finding has been confirmed in developing countries (Fransman and Yu, 2019) and elsewhere (Alkire and Santos 2014; Santos and Villatoro 2018; Trani *et al*. 2016) in the empirical literature.

With respect to administrative districts, the results reveal varying levels of poverty. Individuals from Ngamiland West and Kweneng West experienced the highest incidence of poverty (88.1 per cent and 78.8 per cent respectively), intensity (51.7 per cent and 53.0 per cent respectively) and are the only districts that recorded more than 0.400 in terms of adjusted headcount ratio (0.456 and 0.418 respectively). In contrast, those from Sowa Town and Orapa experienced the lowest levels of poverty.

Table 3.4 Multidimensional poverty measures by geographical variables 2015/16†

Geographical location	Population	(%)	H (%)	A (%)	M_0
Strata					
Cities/towns	438,262	21.1	22.6***	44.1***	0.100***
Urban villages (ref)	911,022	43.9	40.2	45.2	0.182
Rural areas	724,391	34.9	68.1***	49.6***	0.338***
Districts					
Gaborone	238,643	11.5	20.6***	44.0***	0.090***
Francistown	90,992	4.4	28.4***	45.3***	0.129***
Lobatse	23,825	1.1	31.7***	41.7***	0.132***
Selibe Phikwe	53,427	2.6	23.2***	44.4***	0.103***
Orapa	9,532	0.5	12.9***	48.1***	0.062***
Jwaneng	18,856	0.9	13.8***	39.6***	0.055***
Sowa Town	2,987	0.1	4.6***	39.5***	0.018***
Southern	119,739	5.8	56.7***	48.0***	0.272***
Barolong	53,818	2.6	57.6***	46.7***	0.269***
Ngwaketse West	13,517	0.7	61.0***	46.7***	0.285***
South East	90,130	4.3	29.2***	44.8***	0.131***
Kweneng East (ref)	297,420	14.3	44.5	46.1	0.205
Kweneng West	52,441	2.5	78.8***	53.0***	0.418***
Kgatleng	94,258	4.5	35.7***	44.8***	0.160***
Central Serowe/Palapye	184,216	8.9	53.2***	48.5***	0.258***
Central Mahalapye	135,225	6.5	62.8***	47.1***	0.296***
Central Bobonong	64,719	3.1	54.8***	46.0***	0.252***
Central Boteti	57,868	2.8	55.1***	50.2***	0.277***
Central Tutume	143,497	6.9	57.8***	47.9***	0.277***
North East	48,293	2.3	42.6***	44.7***	0.190***

(Cont'd.)

Table 3.4 (Cont'd.)

Geographical location	Population	(%)	H (%)	A (%)	M_0
Ngamiland East	105,845	5.1	48.7***	49.2***	0.240***
Ngamiland West	63,381	3.1	88.1***	51.7***	0.456***
Chobe	24,418	1.2	34.7***	41.8***	0.145***
Ghanzi	45,082	2.2	57.1***	47.3***	0.270***
Kgalagadi South	24,950	1.2	60.2***	46.0***	0.277***
Kgalagadi North	16,594	0.8	53.1***	47.1***	0.250***
Total	**2,073,675**	**100**	**46.2**	**47.4**	**0.219**

Source: Author's own, based on data from SB (2018). †All percentages are estimated at population-level using sample weights. Sample size: 24,720. Significance levels: *p <0.1; **p <0.05; ***p <0.01.

3.3 Inequalities among the left behind

Inequality across society is a growing and highly prominent issue (Alkire and Seth 2014a). Inequality is one of the three important dimensions of the 2030 Agenda that relate closely with LNOB principle (UN 2016a). Notwithstanding this, most of the empirical studies on multidimensional poverty have neglected this issue. This study contributes to the scarce empirical literature on multidimensional poverty and inequality and employs the inequality measure proposed by Alkire and Seth (2014a). This measure summarises empirical information that enables policymakers to assess whether the poorest of the poor (in our case, the left behind) share the benefits of poverty alleviation (Alkire and Seth 2014b). This index lies between zero and one, with zero indicating complete equality (no inequality) and one showing absolute inequality (Hanandita and Tampubolon 2016).

Table 3.5 presents the results of inequality estimates among the multidimensionally poor across different subgroups of the population. Inequality among the multidimensionally poor is estimated at 0.044. The results show no differences in inequality levels among the multidimensionally poor females and males. With respect to age, the results reveal a positive relationship between inequality levels and the age of the individual, with older persons exhibiting higher levels of inequality. These results are consistent with those based on the multidimensional poverty index. This finding is an indication that multidimensional poverty index and the inequality among the poor are positively related (Alkire and Seth 2014b; Espinoza-Delgado and Klasen 2018). Inequality among persons with disability is much higher than among those with no disability. Levels of inequality among the multidimensionally poor are higher for individuals from male-headed households than those from female-headed households. The results suggest a U-shaped relationship between inequality levels and household size.

Further, the results show a declining trend in inequality among the multidimensionally poor with achievement in education. Table 3.5 reveals mixed results across employment status of household head, with multidimensionally poor individuals from a household whose heads are engaged in own farm exhibiting higher inequalities. Similarly, mixed results are observed across quintiles.

Table 3.5 Inequality across demographic and economic variables 2015/16†

Subgroup	H (%)	A (%)	M_0	I_q
Gender				
Female	46.8	47.6	0.223	0.044
Male	45.6	47.1	0.215	0.044
Age				
0 to 17 years (children)	41.7	43.4	0.181	0.032
18 to 35 years (youth)	42.5	46.7	0.198	0.036
36 to 64 years (adults)	51.8	51.1	0.264	0.057
65+ (older persons)	76.6	53.9	0.413	0.076
Disability status				
PWD	73.3	53.8	0.395	0.079
No disability	45.5	47.1	0.214	0.042
Citizenship				
Citizen	47.2	47.4	0.224	0.044
Non-citizen	18.2	46.4	0.085	0.035
Gender of HH				
Female-headed	49.7	46.7	0.232	0.040
Male-headed	42.6	48.2	0.205	0.049
Age of HH				
12–17 (children)	58.1	41.5	0.241	0.042
18–35 (youth)	40.9	46.2	0.189	0.038
36–64 (adults)	43.3	47.1	0.204	0.043
65+ (older persons)	61.0	48.8	0.298	0.050
Marital status of HH				
Married	32.6	46.5	0.151	0.042
Living together	53.8	48.1	0.259	0.048
Separated	52.5	46.5	0.244	0.037
Divorced	38.1	47.4	0.181	0.043
Widowed/Widower	54.1	47.8	0.259	0.045
Never married	51.2	47.2	0.242	0.041
Household size				
1 to 3 members	41.8	49.1	0.205	0.056
4 to 6 members	40.8	46.9	0.192	0.041
More than 7 members	57.3	46.5	0.267	0.038
Educational attainment of HH				
None	67.9	49.9	0.339	0.055
Primary	54.8	46.9	0.257	0.041
Secondary	39.6	44.5	0.176	0.033
Vocational	22.2	42.4	0.094	0.028
University	9.1	44.3	0.040	0.031

(Cont'd.)

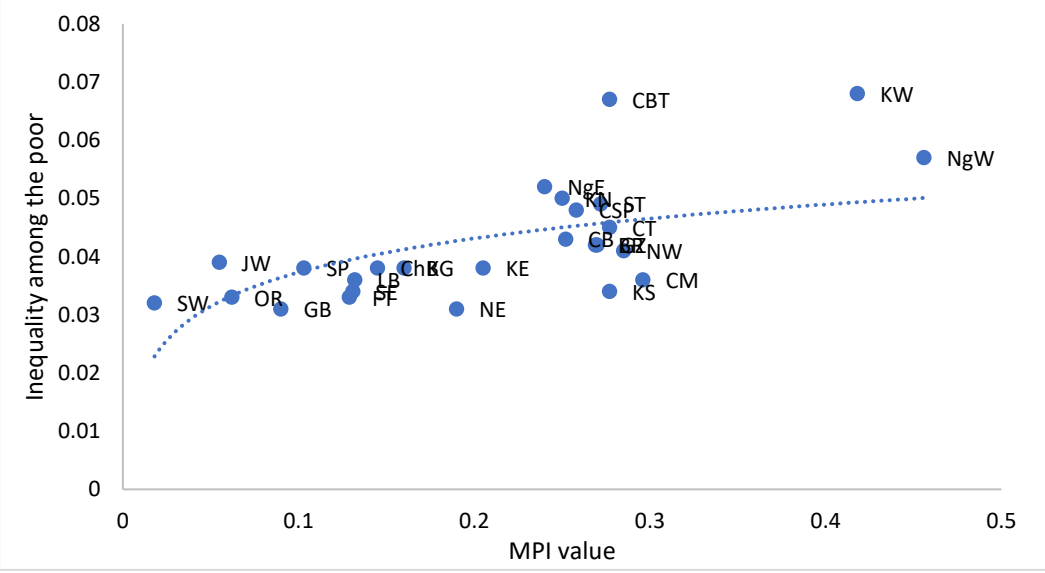
Table 3.5 (Cont'd.)

Subgroup	H (%)	A (%)	M_0	I_q
Employment status of HH				
Unemployed	59.6	47.7	0.284	0.042
Paid employment	26.1	44.6	0.116	0.037
Self-employment	29.7	44.6	0.132	0.039
Own farm	59.8	50.6	0.303	0.064
Family helper	70.1	49.8	0.350	0.054
Quintiles				
Q1	68.3	48.1	0.329	0.044
Q2	51.3	46.9	0.241	0.042
Q3	36.2	46.3	0.168	0.046
Q4	23.8	46.3	0.110	0.048
Q5	11.6	44.8	0.052	0.041
Total	**46.2**	**47.4**	**0.219**	**0.044**

Source: Author's own based on data from SB (2018). HH stands for the household head.
†All percentages are estimated at population-level using sample weights. Sample size: 24,720.

Figure 3.2 depicts inequality and MPI among the multidimensionally poor across districts. The figure depicts a wide variation across administrative districts in inequality among the multidimensionally poor; Kweneng West (KW) exhibited the highest inequality level followed by Central Boteti (CBT) and Ngamiland West (NgW). What is interesting about these three districts is that two of them (Ngamiland West and Kweneng West) have MPI value more than 0.4 while Central Boteti has MPI value less than 0.3. Another interesting observation is that Central Boteti, Central Tutume and Kgalagadi South have the same MPI value of 0.277 but varying levels of inequality. For example, the inequality among the poor in Central Boteti is almost double (0.067) the inequality level of Kgalagadi South (0.034), suggesting that the poor in Central Boteti experience higher levels of intensities of poverty. In contrast, Gaborone and North East recorded the lowest levels of inequality.

Figure 3.2 Inequality and MPI among the multidimensionally poor across districts

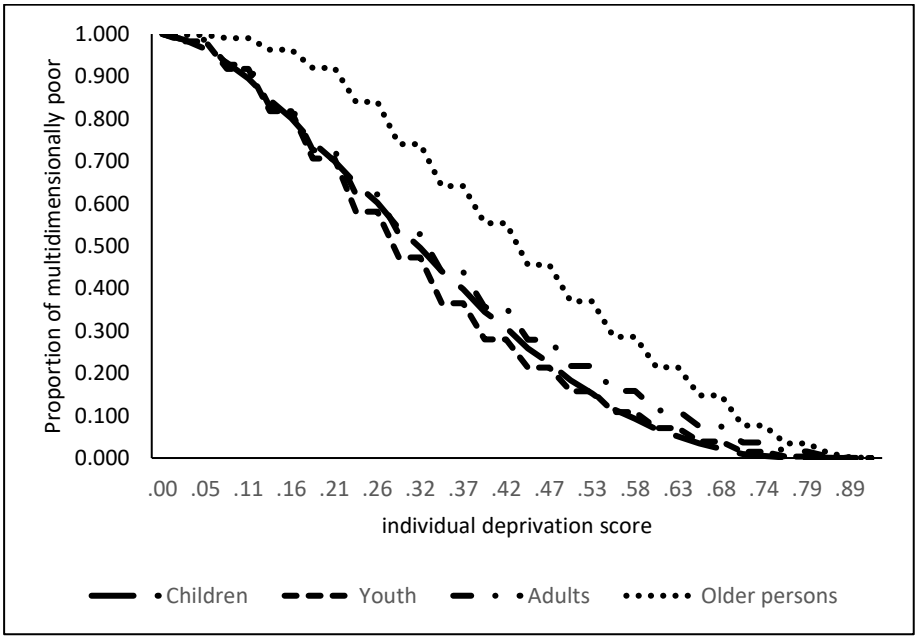


Source: Author's own, based on data from SB (2018). GB: Gaborone; FT: Francistown; LB: Lobatse; SP: Selibe Phikwe; OR: Orapa; JW: Jwaneng; SW: Sowa Town; BR: Barolong; NW: Ngwaketse West; SE: South East; KE: Kweneng East; KW: Kweneng West; KG: Kgatleng; CSP: Central Serowe Palapye; CM: Central Mahalapye; CB: Central Bobonong; CBT: Central Boteti; CT: Central Tutume; NE: North East; NgE: Ngamiland East; NgW: Ngamiland West; ChB: Chobe; GZ: Ghanzi; KS: Kgalagadi South; KN: Kgalagadi North.

4 Robustness analysis

A multidimensional measure is designed based on a choice of diverse parameters (Alkire *et al*. 2015b). Therefore, there is a need to assess how sensitive the estimates are to the selection of different parameters, and if the main conclusions are robust to the different choices of parameters. I, therefore, examine whether the main conclusions are robust to (1) different poverty cut-offs (*k* values) and (2) changes in weighting structure (*w*). Following Alkire *et al*. (2015b), I first employed the complementary cumulative distribution function (CCDF) to investigate whether my results are robust to the choice of a multidimensional poverty line (*k*). Figure 4.1 depicts results for the CCDFs for children, youth, adults, and older persons for various values of *k*. Overall, the results do not find strict first-order stochastic dominance between the CCDFs for different *k* values. In general, the results show that older persons' distribution dominates those of other age groups. That is, no matter what value of *k* I choose, the proportion of multidimensionally poor individuals (H) will always be larger for older persons than for children, youth, and adults. These results confirm the conclusion that older persons have higher levels of multidimensional poverty.

Figure 4.1 Complementary cumulative distribution function (CCDF) by age group



Source: Author's own, based on data from SB (2018)

Second, the robustness analysis involved computing poverty headcount ratios (H), intensity (A) and adjusted headcount ratio (M_0) considering two different poverty cut-offs (*k* values)[28] and alternative weighting schemes[29] across different subgroups of the population. Tables A.4–A.6 present the results. The main conclusions remain robust, with older persons experiencing higher multidimensional poverty levels across all the different scenarios under consideration. I also find that in general poverty headcount ratios (H), intensity (A) and adjusted headcount ratio (M_0) among females were consistently higher across the different poverty cut-offs and the new weighting structure (Table A4). This finding may suggest that multidimensional poverty in Botswana is feminised. However, the gender gaps are minimal. Except for H when *k*=25 and new weighting structure, the results remain robust:

[28] The values of k are limited to a more plausible range of 25 per cent to 40 per cent to conduct restricted tests of dominance (see Alkire and Santos 2014).

[29] In this case I employ equal weighting scheme across all indicators.

multidimensional poverty levels increase with increasing age. The main conclusions remain robust with respect to disability status, where persons with disability have higher poverty levels.

Similarly, citizens experience higher poverty levels than citizens across different scenarios under consideration. With respect to the gender of household head, the results remain robust for the different poverty cut-offs to changes in weighting structure. Except for the second poverty cut-off (k=0.40), the results remain robust. Similar conclusions are observed for marital status, household size and educational status of the household head. The results remain robust with respect to economic variables (employment status of household and income quintiles) (Table A5). In terms of geography (Table A6) results are consistent and robust across strata with rural areas recording higher rates for H, A and M_0 across all the poverty cut-offs and weighting structure considered. Generally, the ordering of the poorest districts did not change with Ngamiland West and Kweneng West ranking one and two (respectively) across the selected parameters. In sum, the results are robust to different choices of parameters and are stable. This robustness analysis proves that even though normative decisions were employed when constructing the index, the public policy conclusions drawn from the index are robust to a choice of diverse parameters.

5 Conclusions and policy implications

Most empirical studies use the household as the unit of analysis for multidimensional poverty measurement. However, estimation of poverty levels at household-level underestimates the poverty levels of the society, does not capture the intra-household inequalities and is not sensitive to demographic characteristics such as gender and age. The call to end poverty in all its forms and for everyone as emphasised by SDG 1.2 acknowledges not only the multidimensional nature of poverty but also that poverty is an individual concept. The LNOB principle also calls for an individual-level analysis of poverty and data disaggregation by different individual characteristics. Therefore, the main objective of this study is to develop an individual-level and country-specific multidimensional poverty measure. Also, the study aims to provide estimates of multidimensional poverty for Botswana. This study contributes to the literature on the multidimensional measure of poverty. It also contributes to the conceptual operationalisation of the LNOB principle, which is applicable in any country context.

The results reveal high multidimensional poverty incidence estimated at 46.2 per cent. This figure is higher than the estimated monetary estimate of 16.3 per cent, an indication that monetary measure alone does not reveal the real picture of the poverty situation in Botswana. Similarly, the results show that on average, the multidimensionally poor are deprived in 47.4 per cent of the deprivation indicators under consideration. This finding is an indication that multidimensional poverty intensity is also a considerable concern in Botswana. Overall the results reveal significant differences in poverty levels across different subgroups. Therefore, a more disaggregated individual-level analysis is needed to identify those left behind.

In conclusion, this paper provides the first attempt to propose an individual-based multidimensional poverty measure for Botswana, to reflect the country's development priorities outlined in NDP 11, Vision 2036 and the proposed BPEPS, as well as the country's commitment to the 2030 Agenda for Sustainable Development. This study also provides policy implications for adopting and using the individual-based multidimensional poverty measure. First, this measure can be used as a tool for monitoring the progress in national development as outlined by different development priorities. Second, there is need to emphasise the importance of the multidimensional individual-level measure of poverty in identifying the poor for policymakers to implement nationally appropriate social protection

systems and to be able to cover those left behind as emphasised by SDG 1.3 of the SDGs (UN 2015). Third, this measure can be used to assess the targeting effectiveness of social protection systems on reaching the poor (Ervin *et al*. 2018). Finally, I hope this paper will set the basis of further discussions and stimulate debates regarding the need for adopting the individual-based multidimensional poverty measure.

Annexe

Table A1 Proportion of deprived individuals in each indicator by individual and household characteristics 2015/16†

Subgroup	IF	DG	TR	LD	OC	CF	FL	RF	WL	EL	WR	TF	EN	LT	SC	HF	CI	FA	WZ	HZ	WH	BM	SF	CR
Gender																								
Male	22.7	57.0	70.5	39.7	40.8	48.5	13.4	10.8	18.5	37.6	11.4	65.3	10.8	8.9	38.9	33.1	12.1	48.9	7.8	17.8	5.6	11.9	39.2	10.3
Female	22.1	55.4	72.2	35.5	39.6	46.5	11.7	10.3	16.7	35.0	8.2	64.1	10.1	8.9	44.0	34.4	21.4	49.5	7.4	16.9	4.8	9.5	40.1	10.5
Citizenship																								
Non-citizen	16.5	37.3	46.1	81.7	31.0	14.2	5.9	5.1	9.5	13.8	10.6	29.3	3.5	1.2	23.4	14.1	8.4	18.7	4.2	7.7	7.5	3.1	35.0	9.7
Citizen	22.6	56.8	72.2	36.0	40.5	48.6	12.8	10.7	17.8	37.0	9.7	65.8	10.6	9.3	42.5	34.5	17.3	50.2	7.7	17.6	5.2	10.8	39.9	10.4
Disability																								
No-disability	22.3	55.9	71.1	38.0	40.4	47.1	12.4	10.4	17.4	35.9	9.5	64.3	10.3	7.9	40.0	33.6	16.0	48.7	7.6	17.4	5.2	10.6	39.6	10.3
PWD	24.1	64.7	82.1	20.2	33.9	58.6	17.8	15.3	23.5	47.2	16.7	75.5	25.0	33.8	82.3	39.3	51.7	65.7	21.7	23.9	0.0	20.7	44.9	12.0
Gender of HH																								
FHH	24.7	59.1	82.1	31.1	40.3	53.2	11.6	10.0	16.1	39.1	6.6	69.8	10.6	8.4	42.7	35.3	17.9	55.3	8.0	17.5	5.1	11.0	41.0	9.9
MHH	19.9	53.0	59.9	44.3	40.0	41.3	13.5	11.2	19.1	33.2	13.0	59.2	10.2	9.5	40.9	32.2	16.1	42.7	7.1	17.2	5.4	10.3	38.3	10.9
Age of HH																								
Children	64.3	80.4	87.0	73.6	40.3	70.8	28.8	19.3	40.1	62.1	11.2	83.3	20.2	0.0	36.7	4.3	9.4	45.9	0.0	0.0	0.0	9.3	21.0	15.6
Youth	20.8	55.5	77.4	71.4	49.7	34.9	12.3	11.1	18.3	36.5	9.8	59.6	11.0	2.1	17.1	29.9	9.7	43.2	7.2	16.9	6.5	8.8	38.5	10.6
Adults	21.0	53.2	65.0	34.3	37.1	45.5	10.8	9.0	15.2	33.2	9.2	61.0	9.5	7.4	44.4	33.4	17.9	46.6	7.6	16.6	4.7	10.9	40.2	10.5
Older persons	27.7	65.3	83.1	7.7	38.3	67.5	17.8	14.5	23.4	44.5	10.9	81.2	12.6	21.7	64.2	39.7	23.0	63.7	8.3	20.5	5.4	11.9	39.7	9.9
Marital status HH																								
Married	16.0	42.5	46.2	32.3	29.4	37.1	8.8	8.6	13.0	20.7	10.2	50.9	7.6	8.0	41.7	31.8	16.7	36.6	4.8	14.9	4.7	9.0	38.1	11.0
Living together	25.6	62.7	80.1	52.7	56.6	49.3	17.6	13.7	24.1	47.3	11.7	70.7	12.4	9.7	40.1	32.8	16.4	52.6	10.7	20.9	5.4	11.6	38.6	9.3
Separated	18.5	49.9	85.4	29.5	34.3	54.9	9.7	10.6	14.8	34.9	2.7	68.6	8.0	6.0	46.4	32.1	19.7	60.8	7.0	16.9	8.5	14.0	46.8	11.2
Divorced	22.8	55.3	65.3	25.9	28.4	43.1	7.9	13.5	16.4	37.6	12.2	53.7	10.4	8.0	38.1	28.3	19.3	37.8	0.0	11.2	0.0	6.1	48.3	19.2

(Cont'd.)

Table A1 (Cont'd.)

Subgroup	IF	DG	TR	LD	OC	CF	FL	RF	WL	EL	WR	TF	EN	LT	SC	HF	CI	FA	WZ	HZ	WH	BM	SF	CR
Widow/Widower	24.8	60.5	84.6	8.7	31.9	63.4	12.6	8.9	16.0	38.1	8.6	78.5	12.7	14.7	57.3	41.0	21.3	61.0	6.8	16.9	3.7	12.1	41.3	10.7
Never married	25.8	64.3	85.2	44.9	42.8	49.7	12.7	10.5	17.8	43.0	8.1	68.6	11.2	7.0	36.3	33.9	15.5	54.7	8.6	17.3	6.7	11.2	40.7	9.8
Education of HH																								
None	32.5	73.5	84.8	14.0	50.5	74.5	23.0	18.8	29.3	54.3	15.4	87.1	14.1	30.3	66.5	37.5	19.1	67.4	9.7	21.8	4.9	13.0	38.6	9.7
Primary	23.4	62.3	80.9	21.2	40.4	59.8	13.3	10.2	19.1	41.9	10.7	77.6	11.7	2.4	64.4	38.5	20.8	58.6	8.7	18.2	5.8	12.0	39.8	9.1
Secondary	19.2	53.4	72.2	58.3	44.9	33.8	7.3	6.9	12.1	31.5	5.9	59.4	8.1	0.8	22.6	32.4	14.6	44.3	6.2	16.1	6.0	10.4	41.7	9.9
Vocational	13.9	41.1	47.8	57.1	31.3	16.9	3.1	3.3	3.9	12.8	3.2	35.4	6.8	0.8	9.1	35.2	16.5	30.8	5.5	12.2	5.5	5.1	43.4	18.3
University	9.5	21.7	33.2	64.9	13.1	8.8	3.8	4.4	6.5	7.0	6.2	16.9	5.2	0.3	9.2	21.1	11.5	12.4	3.8	9.1	3.3	4.6	37.1	12.8
National	22.4	56.2	71.4	37.5	40.2	47.5	12.5	10.6	17.6	36.2	9.7	64.7	10.5	8.9	41.7	33.8	17.0	49.2	7.6	17.4	5.2	10.7	39.7	10.4

Source: Author's own, based on data from SB (2018). †Results are estimated at population-level using sample weights. Sample size: 24,720. IF: information; DG: durable goods; TR: transport; LD: land tenure; OC: overcrowding; CF: cooking fuel; FL: floor; RF: roof; WL: wall; WR: water; TF: toilet facility; EN: enrolment; LT: literacy; SC: school achievement; HF: health facility; CI: chronic illness; FA: food access; WZ: weight-for-age; HZ: height-for-age; WH: weight-for-height; BM: body mass index; SF: safety; CR: crime; PWD persons with disability.

Table A2 Proportion of deprived individuals in each indicator by economic variables and strata 2015/16†

	IF	DG	TR	LD	OC	CF	FL	RF	WL	EL	WR	TF	EN	LT	SC	HF	CI	FA	WZ	HZ	WH	BM	SF	CR
Quintiles																								
Q1	37.5	77.3	92.0	21.5	56.1	71.3	21.5	17.4	29.3	56.9	12.8	88.7	14.6	14.9	55.9	37.8	15.1	70.7	10.3	20.5	5.8	13.4	39.4	7.6
Q2	22.2	61.9	81.1	32.2	40.9	51.8	12.8	10.9	16.2	38.0	10.0	73.3	9.9	10.4	48.3	35.9	18.8	54.9	5.8	15.8	4.8	10.6	40.2	10.6
Q3	13.3	45.1	66.9	45.8	36.5	31.7	6.7	5.9	11.4	26.2	7.6	56.7	6.8	7.7	40.3	34.7	18.0	41.0	4.5	14.0	5.5	8.5	42.0	10.8
Q4	9.4	34.6	47.7	54.4	25.4	17.9	4.9	4.8	8.7	18.6	7.2	38.3	3.7	4.1	31.1	29.7	17.9	24.0	5.6	14.4	4.7	6.6	41.5	12.3
Q5	5.6	23.6	26.0	63.0	14.0	8.7	2.1	2.2	4.1	6.4	5.5	19.6	4.9	1.4	18.3	21.8	17.1	15.9	4.2	11.1	3.3	5.6	34.6	15.1
Employment																								
unemployed	31.2	67.4	84.4	22.7	44.8	63.4	17.5	14.8	23.0	47.2	9.6	79.4	12.4	13.6	51.6	37.8	18.5	63.5	9.5	20.7	5.2	12.7	38.7	9.0
paid employment	13.1	38.7	55.9	61.0	32.0	21.9	4.3	4.6	8.0	18.5	4.4	41.7	6.7	2.4	25.7	30.8	15.2	29.8	5.0	12.5	5.5	8.1	39.7	10.4
Self-employment	13.0	41.4	53.3	33.6	33.1	29.9	3.4	3.2	8.6	20.4	4.2	49.4	7.7	4.1	34.8	31.5	15.0	36.1	4.2	11.8	5.0	8.8	44.5	14.1
own farm	19.8	68.8	68.4	14.0	42.7	73.4	22.9	18.1	28.9	48.7	29.5	80.4	10.9	16.3	59.5	31.7	20.1	57.5	8.7	16.8	4.8	9.8	40.3	14.1
family helper	27.5	79.0	94.8	53.1	59.2	69.8	25.0	15.8	32.1	64.6	25.5	88.6	17.8	13.5	57.7	27.1	16.5	62.9	9.2	23.3	4.7	11.6	37.8	9.9
Strata																								
Cities/Towns	13.8	34.3	53.1	67.7	31.2	11.4	3.3	5.2	6.9	17.5	3.8	23.6	6.9	2.0	23.6	24.7	14.4	26.2	5.2	13.9	4.6	6.7	41.8	11.5
Urban Villages	17.9	49.7	69.8	36.2	35.4	38.7	4.3	3.8	8.4	22.4	3.8	66.6	8.9	6.4	38.4	34.5	16.7	48.8	6.4	16.4	4.6	11.7	43.8	13.0
Rural areas	33.2	77.5	84.3	20.8	51.7	80.3	28.4	22.3	35.6	65.0	20.6	87.1	14.2	17.4	59.2	38.4	19.0	63.7	9.9	19.8	6.1	11.5	33.3	6.4
National	22.4	56.2	71.4	37.5	40.2	47.5	12.5	10.6	17.6	36.2	9.7	64.7	10.5	8.9	41.7	33.8	17.0	49.2	7.6	17.4	5.2	10.7	39.7	10.4

Source: Author's own, based on data from SB (2018). †Results are estimated at population-level using sample weights. Sample size: 24,720. IF: information; DG: durable goods; TR: transport; LD: land tenure; OC: overcrowding; CF: cooking fuel; FL: floor; RF: roof; WL: wall; WR: water; TF: toilet facility; EN: enrolment; LT: literacy; SC: school achievement; HF: health facility; CI: chronic illness; FA: food access; WZ: weight-for-age; HZ: height-for-age; WH: weight-for-height; BM: body mass index; SF: safety; CR: crime.

Table A3 Proportion of deprived individuals in each indicator by administrative district 2015/16†

District	IF	DG	TR	LD	OC	CF	FL	RF	WL	EL	WR	TF	EN	LT	SC	HF	CI	FA	WZ	HZ	WH	BM	SF	CR
Gaborone	11.9	31.0	47.9	61.5	31.0	6.5	4.5	4.6	6.0	14.3	5.3	21.8	5.3	1.2	21.1	23.1	12.7	22.2	3.1	10.7	3.3	5.3	45.1	12.9
Francistown	19.2	40.8	65.8	60.1	31.5	25.5	1.0	1.0	6.3	22.2	1.2	24.8	8.9	3.2	25.8	34.4	16.2	35.9	8.9	18.3	9.3	8.9	42.6	11.2
Lobatse	15.3	48.0	72.5	70.8	36.0	5.2	0.0	0.0	3.8	31.6	1.0	49.2	9.9	2.4	29.2	14.9	16.3	40.7	6.1	21.4	4.2	9.9	33.9	9.8
S/Phikwe	8.9	35.9	51.2	90.6	35.5	15.6	1.8	18.6	12.9	22.3	1.5	28.8	6.8	3.8	28.3	19.2	18.2	26.9	6.2	16.8	3.5	6.8	38.4	8.7
Orapa	43.5	52.4	63.4	100	11.4	6.6	6.6	6.6	6.6	6.6	6.6	6.6	0.0	0.0	30.2	1.5	16.8	10.9	9.7	14.7	5.1	0.0	15.0	10.1
Jwaneng	9.4	17.1	34.2	93.6	27.8	5.5	5.3	2.0	5.3	11.7	5.5	5.6	7.5	2.1	24.8	36.4	13.2	19.5	5.1	5.1	3.0	7.5	35.1	7.6
Sowa Town	2.7	16.0	49.4	100	1.3	11.2	0.0	0.7	24.8	0.0	4.2	0.0	15.8	1.1	22.3	33.2	13.2	13.4	0.0	24.6	0.0	15.8	8.5	4.7
Southern	25.3	67.3	82.8	21.4	36.8	60.1	11.8	9.5	20.4	44.7	19.0	79.9	17.0	14.0	53.9	34.2	17.9	63.7	7.0	16.4	4.7	17.0	36.2	12.1
Barolong	14.9	69.7	80.0	25.8	35.0	69.2	4.5	4.2	9.1	46.5	19.0	80.7	13.3	12.2	54.2	45.3	17.6	67.7	8.0	23.6	8.2	13.3	30.2	5.6
Ngwaketse W	36.6	80.1	91.4	10.6	54.7	90.4	20.0	11.3	25.1	56.2	4.1	84.9	13.1	22.5	52.7	34.2	15.2	65.2	0.0	11.1	0.0	13.1	24.5	0.7
South East	19.5	37.8	66.2	43.1	26.6	22.2	2.8	4.0	4.8	14.9	7.4	47.9	5.2	3.6	30.1	28.1	15.9	37.4	6.5	12.4	0.0	5.2	44.6	10.4
Kweneng E	17.6	53.3	68.5	38.7	38.4	33.8	4.6	4.2	7.5	30.2	9.2	71.8	13.4	9.0	39.1	37.3	14.5	47.4	7.6	15.3	7.3	13.4	50.0	14.3
Kweneng W	48.1	83.8	90.8	21.4	63.5	86.5	36.4	32.8	37.9	76.8	26.6	92.5	15.8	22.6	62.0	43.8	20.4	81.1	11.0	26.7	4.2	15.8	33.2	7.5
Kgatleng	15.8	40.6	65.1	24.6	29.9	39.3	3.6	1.7	8.8	23.9	6.2	71.6	10.5	8.5	43.6	31.2	16.0	44.7	5.8	15.5	8.3	10.5	41.3	9.4
Central SP	24.1	58.4	75.7	31.6	44.1	57.7	16.4	11.9	21.7	39.2	9.9	72.0	9.6	10.5	52.6	35.9	22.2	57.6	9.6	20.2	5.3	9.6	40.6	11.2
Central MH	29.9	69.9	82.3	21.0	46.9	71.7	10.6	8.2	16.4	49.3	7.4	83.8	9.4	10.2	51.0	43.7	20.3	59.7	6.1	15.6	2.8	9.4	47.0	7.9
Central BB	24.6	73.6	82.4	15.8	48.3	74.2	10.6	5.2	18.1	45.4	10.4	81.9	11.8	9.4	52.8	32.3	20.5	56.5	6.0	22.7	3.2	11.8	33.9	8.8
Central BT	19.9	64.7	73.3	35.9	51.4	62.8	30.7	16.5	30.0	41.6	17.8	78.2	9.8	14.0	45.0	42.5	15.6	55.2	14.4	22.6	7.1	9.8	27.8	10.1
Central TT	31.2	69.0	81.2	21.9	40.9	75.1	27.3	24.8	36.8	53.3	12.5	78.0	12.4	12.3	53.8	29.7	18.4	53.9	9.1	22.1	5.7	12.4	33.8	8.2
North East	18.6	59.7	75.9	41.2	24.5	67.0	7.3	11.5	12.1	36.8	6.1	70.3	12.6	4.7	48.9	24.0	19.7	43.0	8.7	20.8	3.1	12.6	33.8	3.9
Ngamiland E	26.9	65.0	70.7	26.8	54.8	55.4	18.3	9.1	22.4	35.0	11.5	80.2	7.2	9.5	43.1	38.3	15.3	56.6	6.2	15.7	4.5	7.2	35.1	14.3
Ngamiland W	39.3	91.1	92.8	12.6	65.2	92.1	61.1	67.3	71.6	78.0	16.5	98.0	11.8	27.3	61.5	49.6	16.7	83.0	5.4	9.8	7.3	11.8	29.2	4.7
Chobe	20.1	42.3	75.4	65.9	33.9	33.3	4.7	3.6	15.3	19.8	2.4	49.1	7.2	4.7	29.1	34.7	17.6	29.2	6.2	13.2	5.9	7.2	46.9	4.1
Ghanzi	31.6	65.9	79.3	32.7	51.7	64.9	25.5	9.9	35.2	54.1	7.3	67.8	13.8	15.1	54.7	31.7	16.8	62.6	18.0	22.8	9.3	13.8	29.9	10.1
Kgalagadi S	36.5	73.2	81.3	32.5	46.7	78.7	12.9	1.8	14.1	53.1	9.4	86.1	13.1	8.0	56.8	30.9	18.4	58.7	12.5	22.9	1.9	13.1	15.0	6.6
Kgalagadi N	14.6	63.5	75.1	38.8	48.5	49.0	11.6	3.6	25.4	41.3	12.2	77.2	11.1	13.5	44.8	38.7	21.9	53.3	8.2	28.0	5.8	11.1	38.9	6.1
National	22.4	56.2	71.4	37.5	40.2	47.5	12.5	10.6	17.6	36.2	9.7	64.7	10.5	8.9	41.7	33.8	17.0	49.2	7.6	17.4	5.2	10.7	39.7	10.4

Source: Author's own, based on data from SB (2018). †Results are estimated at population-level using sample weights. Sample size: 24,720. IF: information; DG: durable goods; TR: transport; LD: land tenure; OC: overcrowding; CF: cooking fuel; FL: floor; RF: roof; WL: wall; WR: water; TF: toilet facility; EN: enrolment; LT: literacy; SC: school achievement; HF: health facility; CI: chronic illness; FA: food access; WZ: weight-for-age; HZ: height-for-age; WH: weight-for-height; BM: body mass index; SF: safety; CR: crime. W: west, E: east; S: south; SP: Serowe Palapye; MH: Mahalapye; BB: Bobonong; BT: Boteti; TT: Tutume.

Table A4 Multidimensional poverty estimates using alternative parameters by demographics 2015/16†

	k=25			*k*=40			Equal weight[a]		
Subgroup	**H (%)**	**A (%)**	**M_0**	**H (%)**	**A (%)**	**M_0**	**H (%)**	**A (%)**	**M_0**
Gender									
Female	60.4	43.5	0.263	33.0	52.2	0.172	42.7	49.6	0.212
Male	59.2	43.0	0.255	31.7	51.8	0.164	42.8	50.1	0.214
Age									
0 to 17 years (children)	57.9	39.5	0.228	24.4	48.5	0.118	44.0	47.8	0.211
18 to 35 years (youth)	55.7	42.6	0.237	30.2	50.9	0.154	36.5	49.6	0.181
36 to 64 years (adults)	62.6	47.4	0.296	41.6	54.6	0.227	43.9	51.9	0.228
65+ (older persons)	86.8	51.1	0.443	63.3	57.5	0.364	64.1	54.5	0.349
Disability status									
PWD	82.6	51.2	0.423	60.7	57.4	0.348	61.0	54.4	0.332
No disability	59.2	43.0	0.254	31.6	51.7	0.163	42.2	49.6	0.210
Citizenship									
Citizen	61.0	43.3	0.264	33.1	52.0	0.172	43.6	49.8	0.217
Non-citizen	25.9	41.3	0.107	11.9	51.7	0.061	17.0	49.6	0.084
Gender of HH									
Female-headed	64.5	42.8	0.276	34.2	51.4	0.176	46.5	48.8	0.198
Male-headed	54.9	43.9	0.241	30.6	52.7	0.161	38.8	51.1	0.227
Age of HH									
12-17 (children)	73.8	39.0	0.288	21.4	50.2	0.108	65.6	50.7	0.333
18-35 (youth)	55.6	41.7	0.232	27.5	51.0	0.140	40.4	49.6	0.200
36-64 (adults)	56.4	43.1	0.243	30.1	51.8	0.156	39.5	49.5	0.196
65+ (older persons)	75.0	45.1	0.338	45.1	53.1	0.239	54.8	50.8	0.278
Marital status of HH									
Married	44.6	41.9	0.187	21.7	51.5	0.112	27.3	49.3	0.135
Living together	67.3	44.4	0.299	38.4	52.7	0.203	53.4	50.8	0.271
Separated	65.0	43.1	0.280	35.6	51.2	0.182	47.8	47.8	0.228
Divorced	52.9	42.6	0.225	28.6	51.1	0.146	35.4	50.1	0.177
Widowed/Widower	70.0	43.7	0.306	38.7	52.3	0.203	48.1	48.7	0.234
Never married	65.7	43.2	0.284	36.2	51.7	0.187	48.3	49.8	0.241
Household size									
1 to 3 members	54.3	44.6	0.242	30.5	53.8	0.164	37.5	51.2	0.192
4 to 6 members	53.8	42.7	0.230	28.1	51.7	0.145	37.0	49.7	0.184
More than 7 members	72.8	42.9	0.312	39.6	51.0	0.202	55.1	49.1	0.270
Education of HH									
None	80.6	46.7	0.376	52.1	53.9	0.281	65.0	52.2	0.339
Primary	71.0	42.9	0.305	38.1	51.4	0.196	49.6	49.0	0.243
Secondary	55.4	40.2	0.223	24.6	49.5	0.122	36.6	46.8	0.171
Vocational	36.3	37.4	0.136	12.4	47.1	0.058	16.5	44.8	0.074
University	15.7	38.0	0.060	5.3	50.0	0.026	6.9	52.5	0.036
Total	**59.9**	**43.3**	**0.259**	**32.4**	**52.0**	**0.169**	**42.7**	**49.8**	**0.213**

Source: Author's own, based on data from SB (2018). HH stands for the household head.
†All percentages are estimated at population-level using sample weights. Sample size: 24,720. [a]Equal weighting structure across indicators.

Table A5 Multidimensional poverty estimates using alternative parameters by economic variables 2015/16[†]

	k=25			*k*=40			Equal weight[a]		
Economic variables	**H (%)**	**A (%)**	**M_0**	**H (%)**	**A (%)**	**M_0**	**H (%)**	**A (%)**	**M_0**
Employment of HH									
Unemployed	73.5	44.3	0.325	43.2	51.9	0.224	55.8	50.4	0.281
Paid employment	39.9	39.4	0.157	15.6	50.1	0.078	22.5	46.4	0.104
Self-employment	43.6	39.7	0.173	17.9	50.1	0.090	25.3	45.0	0.114
Own farm	72.3	46.8	0.339	47.1	54.5	0.257	56.2	53.0	0.298
Family helper	82.0	46.9	0.384	52.8	54.1	0.286	70.6	52.7	0.372
Quintiles									
Q1	82.9	44.8	0.372	50.3	52.3	0.263	67.6	50.7	0.343
Q2	67.0	42.9	0.287	35.7	51.5	0.184	46.4	48.9	0.227
Q3	50.8	41.5	0.211	22.9	51.9	0.119	30.0	48.6	0.146
Q4	36.1	40.5	0.146	15.2	52.1	0.079	18.9	49.0	0.092
Q5	18.8	38.9	0.073	6.9	52.3	0.035	8.0	45.9	0.037
Total	**59.9**	**43.3**	**0.259**	**32.4**	**52.0**	**0.169**	**42.7**	**49.8**	**0.213**

Source: Author's own, based on data from SB (2018). HH stands for the household head. [a]Equal weighting structure across indicators. [†]All percentages are estimated at population-level using sample weights. Sample size: 24,720. Per capita quintiles were calculated at household-level.

Table A6 Multidimensional poverty estimates using alternative parameters by geography 2015/16†

	k=25			*k*=40			Equal weight[a]		
Geographical location	**H (%)**	**A (%)**	**M_0**	**H (%)**	**A (%)**	**M_0**	**H (%)**	**A (%)**	**M_0**
Strata									
Cities/towns	33.9	39.2	0.133	13.3	49.6	0.066	20.1	46.2	0.093
Urban villages	56.1	40.8	0.229	25.6	50.2	0.128	33.4	45.9	0.153
Rural areas	80.3	46.5	0.374	52.5	53.5	0.281	68.2	52.9	0.361
Districts									
Gaborone	31.4	39.0	0.122	12.3	49.2	0.060	17.7	47.3	0.084
Francistown	41.2	40.4	0.167	18.3	50.2	0.092	25.5	45.5	0.116
Lobatse	46.8	37.8	0.177	15.6	47.4	0.074	31.7	40.4	0.128
Selibe Phikwe	34.8	39.4	0.137	12.8	50.7	0.065	22.7	45.7	0.104
Orapa	18.0	42.7	0.077	10.3	51.4	0.053	10.3	58.2	0.060
Jwaneng	23.2	35.4	0.082	4.4	47.1	0.021	9.8	48.6	0.048
Sowa Town	13.1	33.1	0.043	1.4	45.2	0.006	1.4	36.8	0.005
Southern	71.2	44.3	0.315	40.7	52.6	0.214	51.1	50.3	0.257
Barolong	74.4	42.9	0.319	39.0	51.6	0.201	53.2	46.3	0.246
Ngwaketse West	82.9	42.1	0.349	41.7	51.7	0.215	67.0	47.4	0.317
South East	42.9	40.0	0.172	18.5	49.7	0.092	21.3	47.6	0.101
Kweneng East	60.5	41.7	0.252	30.2	50.6	0.153	38.3	46.1	0.176
Kweneng West	87.3	50.7	0.442	68.0	55.7	0.379	79.4	56.3	0.447
Kgatleng	53.3	39.8	0.212	22.3	49.9	0.111	27.4	46.2	0.126
Central Serowe/Palapye	66.6	44.7	0.297	39.4	52.7	0.208	47.9	51.7	0.248
Central Mahalapye	74.4	44.3	0.330	45.2	51.1	0.231	58.9	49.0	0.289
Central Bobonong	72.3	41.9	0.302	35.9	51.2	0.184	53.4	47.7	0.254
Central Boteti	67.0	46.4	0.311	40.8	55.2	0.225	50.7	54.9	0.278
Central Tutume	70.5	44.6	0.315	40.7	52.6	0.214	58.9	51.9	0.306
North East	59.6	40.3	0.240	27.9	49.1	0.137	41.4	46.8	0.194
Ngamiland East	65.2	44.2	0.288	36.7	53.5	0.196	47.4	50.7	0.241
Ngamiland West	94.5	50.2	0.475	73.8	54.6	0.403	88.7	57.6	0.511
Chobe	47.9	38.3	0.183	16.7	48.0	0.080	31.6	44.0	0.139
Ghanzi	71.8	43.6	0.313	38.7	52.2	0.202	55.3	51.3	0.284
Kgalagadi South	72.0	43.4	0.312	40.9	50.6	0.207	61.0	47.9	0.292
Kgalagadi North	71.3	42.6	0.304	34.2	52.9	0.181	50.8	48.5	0.246
Total	**59.9**	**43.3**	**0.259**	**32.4**	**52.0**	**0.169**	**42.7**	**49.8**	**0.213**

Source: Author's own based on data from SB (2018).
†All percentages are estimated at population-level using sample weights. Sample size: 24,720. [a]Equal weighting structure across indicators.

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