Estimating the completeness of adult death reporting in South Africa, 2011-2016

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Risenga Maluleke

Statistician-General

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For technical enquiries, please contact:

Diego Iturralde
Email: DiegoI@statssa.gov.za
Tel: 012 310 8922

Olga Lesego Bodigelo
Email: OlgaM@statssa.gov.za
Tel: 012 310 6914

User information services: (012) 310 8600/8390/8351/4892/8496/8095
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Preface

Statistics South Africa (Stats SA) is mandated to provide the state and other stakeholders with official statistics on the demographic, economic and social situation of the country to support planning, monitoring and evaluation of the implementation of programmes and other initiatives. As such, Stats SA has conducted three Censuses (1996, 2001 and 2011) and various household-based surveys. These data sources have been widely used to produce demographic indicators for evidence-based decision-making in the country. However, the use of administrative data from Civil Registration and Vital Statistics (CRVS) systems remains minimal, especially in the context of estimating completeness of death registration. As a step to encourage use of mortality data from the South African CRVS system, the current report looked at the completeness of adult death registration (reporting) in South Africa in the inter-censal period 2011-2016. Estimated completeness is disaggregated by sex, province and population group.

Acknowledgements

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Abbreviations

CRVS	Civil Registration and Vital Statistics
CS	Community Survey
DDM	Death Distribution Methods
GGB	Generalized Growth Balance method
HDSS	Health and Demographic Surveillance System
IUSSP	International Union for the Scientific Study of Population
k_2	Parameter of completeness of enumeration
PES	Post-enumeration Survey
SEG	Synthetic Extinct Generations method
SDG	Sustainable Development Goals
Stats SA	Statistics South Africa
UN	United Nation
UNESCWA	United Nations Economic and Social Commission for Western Asia
UNSD	United Nations Sustainable Development Goals
WHO	World Health Organisation

Executive Summary

The study examined the completeness of adult death reporting in the inter-censal period 2011–2016 in South Africa. Assessment of the data quality revealed that the data distributions are reasonable to apply in the estimation processes. Examination of observed age-specific death rates revealed patterns that are typically higher among males, less developed provinces and black African population.

In using the Generalized Growth Balance (GGB) method and controlling for errors, results of completeness of adult death reporting among the male population show that provinces such as Northern Cape (91%), Gauteng (85%), closely followed by Western Cape (82%) recorded the highest levels of completeness. Provinces such as Eastern Cape (51%) and Mpumalanga (53%) reported the least in the inter-censal period. Presenting almost the same level, the same provinces reported the highest levels of completeness among females, with provinces such as Mpumalanga, Limpopo and Eastern Cape reporting the least. With slight difference in the levels of completeness, the study also revealed that patterns reported using the GGB method were similar with those reported using the Synthetic Extinct Generations (SEG) method.

The results using the GGB method among men show that the white male population (75%) reported the highest completeness levels, while at 60% Indians/Asian male population reported the least. The levels by female population show that the white population (85%) reported the highest completeness levels of adult death reporting, while at 66% black African population reported the least.

Overall, patterns obtained using the GGB method were almost consistent using the SEG method for both sexes. Although commendable, these levels revealed inconsistencies in completeness derived by population group, compared to those derived for the country. Thus, suggesting that completeness has not fully improved by population group. This observation is a concern and calls for further research.
Results from the study indicate that the levels of completeness among the male population speaks to that of the female population, and completeness levels using both methods are also similar. They are consistent with that of previous estimates in the country as well. These methods specific validating checks reveal the correctness of the estimates derived in the study.

At the national level, the GGB method reported the same percentage at 96% for both sexes. The result suggests consistency with that of Stats SA (2021). Overall, findings from the study revealed that the completeness of adult death reporting is high and improving in South Africa.

Risenga Maluleke
Statistician-General

1. Background

Completeness of death registration (adult death reporting) is a measure of the extent to which deaths occurring in a country are captured by the civil registration system in a year (WHO, 2010). The concept is also expressed as the share or percentage of deaths captured by countries' vital registration system (Kumar & Balaiah, 2013; UN, 2014; Stats SA, 2019; Karlinsky, 2021). Research on completeness of adult death registration at the national and subnational level is conducted to monitor performance of the CRVS system, examine outcomes of disease, extent of the mortality burden and target interventions accordingly (Adair & Lopez, 2018; Bradshaw et al., 2017; WHO, 2021; Stats SA, 2019; Udjo, 2017; UNSD, 2014). In terms of mortality estimation, it is necessary to know by how much to adjust death registration data to produce mortality statistics that will serve the current needs of planners (ibid).

Sitting under SDG goal 3, the completeness of death registration indicator seeks to "Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development" (Mills et al., 2017: 154). Stats SA (2019) in reference to UN (2018) wrote that the attainment of completeness of CRVS is important in its own right as it serves as an indicator for the derivation of "SDG target 16.9 and 17.19 on legal identity and data quality improvement" (Stats SA, 2019:9). Also, empirical thinking suggests that having completeness of death registration in the framework of the SDG qualifies continuous research in the area, especially disaggregated by sex, province and other demographics.

The study of adult mortality and related indicators such as completeness of reporting of adult death in less developed countries is problematic due to data quality issues. Incomplete vital registration, coverage or incompleteness of censuses, limited and inaccurate place of residence and misreporting of age at death or age of the living are among the problems often encountered by researchers wishing to use the CRVS, surveys and census datasets (UN, 1983, 2002; Bhat, 1990; Udjo, 2017; Hill, You & Choi, 2009). With South Africa not being an exception, "estimating the completeness of birth and death registration in South Africa is difficult for several reasons" (Garenne et al., 2016:2). For instance, the denominator, i.e. "the precise number of total births and deaths that occur in the country, is controversial, and various estimates derived from censuses, demographic surveys and models vary by a margin of 10% or more" (ibid.).

The flaws of incomplete vital registration data and the over- and underreporting of deaths by age in South Africa were attested to by studies such as Hill et al. (2009a, 2009b, 2005), Hill (2003, 2004) and Brass (1975). According to these studies, mortality estimates and the knowledge of the levels and trends of adult mortality are limited by the quality of available data. The most common is incomplete coverage of the vital registration system and errors in age declaration for both population and deaths counts (UN, 1997; 2002). In South Africa, literature suggests that the vital registration system dates back to 1924, indicating that the country has a long history of death registration (Udjo, 2022; Khafani et al., 2005). With official compilation dating back to 1997, empirical evidence suggests that major improvements have been recorded in the last two decades in the country (Chinogurei, 2017; Garenne et al., 2016; Udjo, 2022). This is so, despite these flaws and uncertainties.

Past studies in South Africa have estimated the completeness of death registration using different methods. For example, in using the Agincourt HDSS 1992–2014 data, Garenne et al. (2016) observed a speedy increase in the levels of completeness in the rural areas. According to the study, "Completeness increased for all demographic and socio-economic categories studied and is likely to approach 100% in the future if trends continue at this speed" (Garenne et al., 2016:1). Using the 1996 data, Dorrington et al. (2004) estimated completeness levels to be 86% for both adult males and females in their sixties in South Africa. Groenewald et al. (2005) revealed the completeness levels in the early 2000s to be above 90% (Groenewald et al., 2005; Udjo, 2017). However, using the age range 15 years and older, Stats SA (2011) found that the completeness level of adult deaths was 89% for the inter-censal period 1996–2001. Dorrington (2013) also revealed a completeness level of 91% for the male and 89% for the female population using the GGB method, and 94% for the male and 93% for the female population using the SEG method in the inter-censal/survey period of 2001–2007 in South Africa (Dorrington., 2013; Moultrie et al., 2013). Also, in using the age range of 15 years and older, a completeness level of 94% was reported for South Africa in the 2007–2011 inter-censal period (Udjo, 2017). Using the same age range, Stats SA (2021) reported a completeness level of 96% (average) for South Africa in the 2011–2016 inter-censal period.

However, whilst these works are commendable, a closer review suggests that disaggregation of completeness levels of adult death reporting and their parameters of completeness of enumerations have not been carried out, especially by province and population group in the inter-censal period 2011–2016 in South Africa. This indicates gaps which need to be addressed. In the light of the above, this report estimated the completeness levels of adult death reporting and the parameters of enumerations in South Africa for this period. Estimation of completeness levels and the values used in obtaining the parameters of enumeration were carried out using the GGB and SEG methods. These were disaggregated by sex, province and population group. It is envisaged that doing so will not only add to the literature, but will also result in broader knowledge, leading to informed policy and programme development in South Africa.

2. Study objectives

The study aimed at estimating the completeness of adult death reporting in the inter-censal period 2011–2016 in South Africa. Specifically, the study examined the completeness of adult death reporting (registration), the parameter of completeness of enumeration and deviations as a complementary assessment, disaggregated by sex, province and population group in South Africa.

3. Methodology

3.1 Study method

To reduce the negative effects of data issues, different methodologies have been developed to estimate completeness and evaluate data quality. Prominent among these are the Death Distribution Methods (DDMs). As indirect methods, the DDMs include the Generalized Growth Balance (GGB) Method (Hill, 1987), and the Synthetic Extinct Generations method (SEG) methods (Benneth & Horiuchi, 1981). They compare the distribution of deaths by age with the age distribution of the living and provide age patterns of mortality (45q15) in a defined reference period (ibid.). The methods estimate the completeness of death reporting in an inter-censal period, i.e. using data collected at two data collection points (Moultrie et al. 2013; Dorrington, 2013). They also provide values needed in estimation of the relative completeness of enumeration.

These DDMs make several assumptions about population dynamics. These assumptions include the notion of the population being closed to migration, which makes subnational application of the methods problematic (Preston & Coale et al. 1980). Other assumptions stipulate that the recording of the population is complete and that ages of the living and the dead are reported without errors (ibid). Studies have also shown that these methods have some limitations. For instance, incompleteness, complexity and inaccurate estimates can be observed where method assumptions are violated (Adair & Lopez, 2018; Queiroz et al., 2020; Kumar et al., 2013; Chisumpa, 2018; Schmertmann & Gonzaga, 2018; Sen, 2001). In addition, inconsistent estimates can be derived, depending on the data and method used when compared with other DDMs (Dorrington, 2013; Kumar et al. 2013; Adair & Lopez, 2018).

The assumption of the SEG and GGB methods that the population is closed to migration is of importance to the South African context. The country has conducted three censuses and two community surveys (CS), with data on interprovincial migration provided. However, since the methods are disaggregated by province, i.e. are applied to sub-national geographic areas in the study, the issue of migration typically becomes a greater concern.

In South Africa, empirical evidence suggests a high migration flow. The patterns suggest that migration rates are typically highest among young adults, and drop sharply at middle ages. Therefore, in fitting the estimation method to data with significant migration and in doing this, limit errors arising from net migration, early studies suggest the use of a high starting age from 30 or 35 for the fitting range (Moultrie et al. 2013; Dorrington, 2013). According to studies, such an approach may reduce the effects of migration, and also increase the effects of age misreporting that may get worse with increasing age (ibid). Specifically, Dorrington (2013) acknowledged the possibility of lack of reliable net migration estimates in the inter-censal periods. Therefore, given such situations, the author recommends estimating completeness by fitting the straight line to the data from age 35 and older to address the issue of migration (Dorrington, 2013). Specifically, in populations thought not to be affected by migration, the author recommends the fitting of the age range of 5+ to 65+ as an ideal strategy and the age range of 30+ to 75+ in the population with high migration (Dorrington, 2013).

Results show that the application of these methods in many instances work very well when the only errors in the data are those which the methods were developed for. However, they can be very sensitive to errors for which they were not designed for, in particular, substantial migration or age errors of reporting deaths and population. On average, adjusted mortality estimates using these methods are closer to the true values than the unadjusted (Hill, You & Choi, 2009). Therefore, given the contexts above, and keeping in mind that “The points corresponding to older persons (15 years and over) often produce a better fitting than the inclusion of points corresponding to persons younger than 15 years” (Udjo, 2017:4), most age ranges used to fit the straight line in the study were 15 years and older. Also, in estimating completeness of death reporting, migration distribution was not factored by population group in this study. This is so because of the complexity of obtaining net migration, especially by population group and at the national level.

Early reports in South Africa (Dorrington, 2013; Dorrington et al., 2004) recommend a comparison of male results with that of females, and the use of the SEG method as validations to the GGB method. They also recommend that estimates obtained using these methods be compared with those of the country’s previous estimates (Dorrington, 2013; Dorrington, Moultrie & Timæus, 2004). In estimating the completeness, these validating recommendations were highly considered (observed) among others in this study.

3.2 Data sources and analysis

The study utilised three nationally representative datasets. These are the Census 2011, CS 2016, and South Africa’s CRVS – mortality and causes of death registration data, collected between 2011 and 2016 in the country. Deaths from the CRVS were prorated to reflect only deaths in the inter-censal period. Adjustments and estimation of completeness levels, including the values used in obtaining the parameter of enumeration, were achieved using Excel templates obtained from the International Union for the Scientific Study of Population (IUSSP) website (Moultrie et al., 2013; Dorrington, 2013; Stats SA, 2015). Further details about these datasets and templates can be obtained from Moultrie et al. (2013), Dorrington (2013) and other relevant Stats SA reports.

4. Quality statement on input data

Early studies (Dorrington, 2013; Moultrie et al., 2013) recommend the assessment of the quality of age and sex structure of the population and deaths prior to use, in the application of the death distribution methods. Findings from these reviews served as a guide during method application.

4.1 Assessment of population age and sex structure, 2011 and 2016

Figures 1 and 2 show the distribution patterns of the population by single age and sex for 2011 and 2016. Assessment of the distribution shows patterns that are consistent with expectations in South Africa. Closer examination of the 2011 and 2016 data show slight elements of age heaping. Heaping “usually – but not always – takes the form of concentrations of the age distribution of the population on ages ending in 0 or 5” (Moultrie et al., 2013:8). Also, further disaggregation by province and population groups might reveal data inconsistencies. However, an early report by Stats SA (2017) revealed a UN Accuracy Index of 18,2 for Census 2011 and 16,7 for CS 2016. These values indicate reasonable population datasets (Stats SA, 2017), which can be used for the study.

Figure 1: Distribution patterns of population by single age and sex, 2011

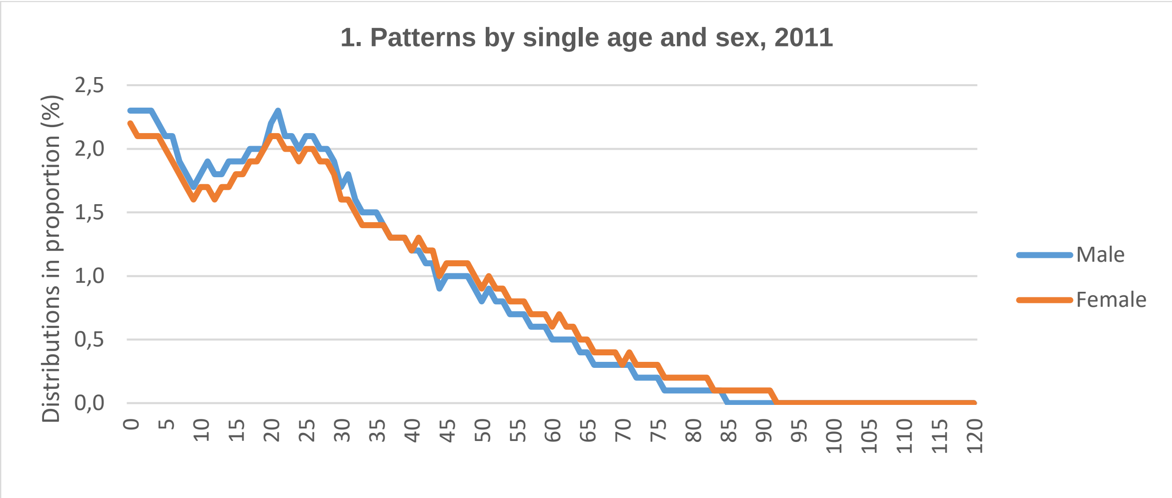
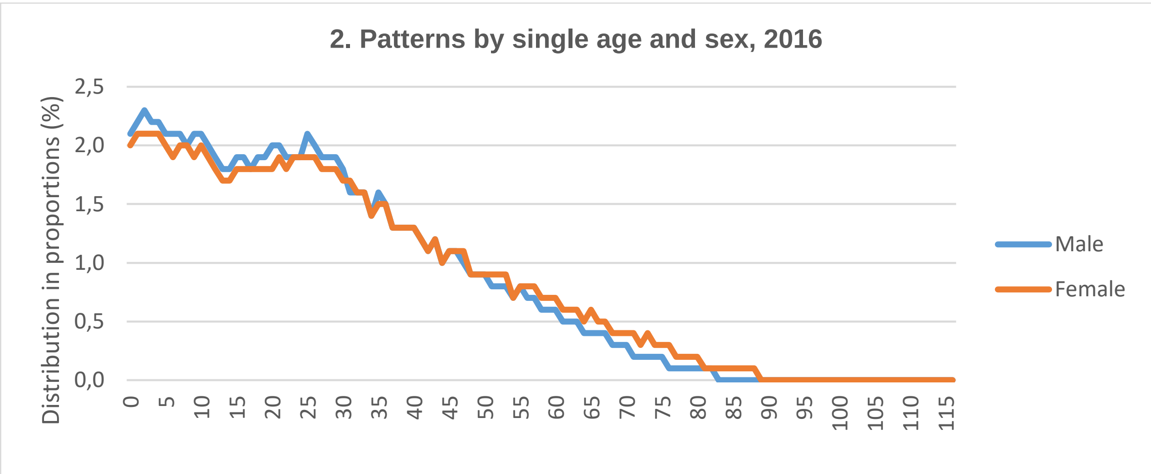


Figure 2: Distribution patterns of population by single age and sex, 2016



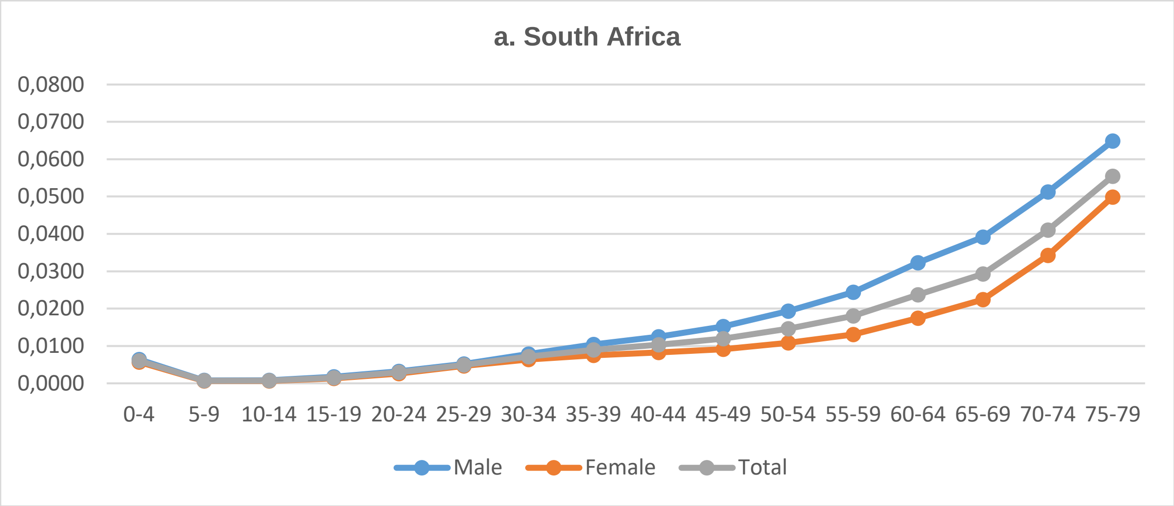
4.2 Evaluation of deaths from CRVS, 2011–2016

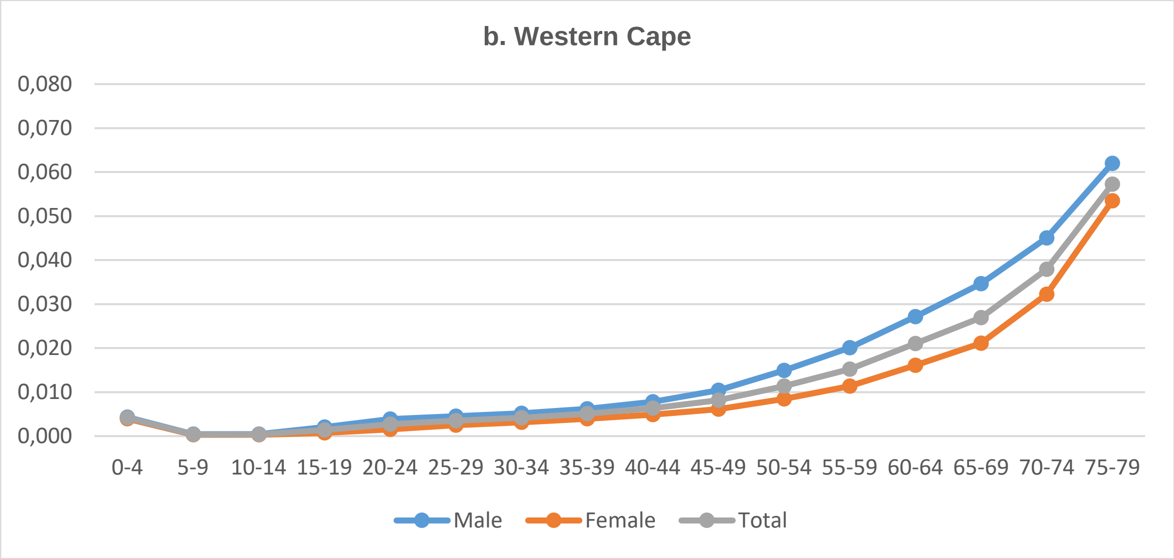
In general, quality assessment of deaths from CRVS involves analysing the age and sex patterns of mortality distribution by geography and socio-economic status of the population (if available), as well as time analysis of the death distribution. Figures 3a–j and 4k–n below highlight the observed age–specific death rates patterns by province and population group in South Africa, CRVS 2011 to 2016.

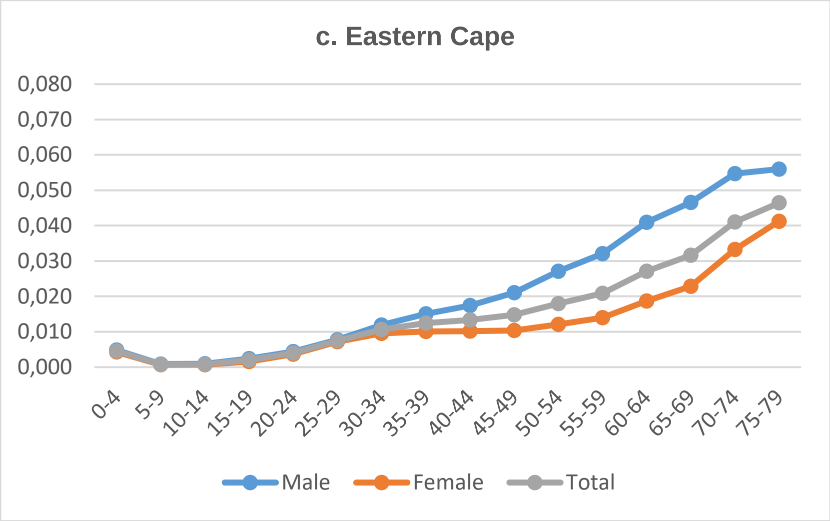
A situation where mortality decreases with age at older ages suggests data quality issues (UNESCWA, 2002) and this anomaly was not detected in the mortality data. The results suggest that the deaths from CRVS (2011–2016) conform to the standard mortality pattern for South Africa. Mortality is noticeably high in the first years of life (0–4) and drops at 5–9 years. These patterns are followed by a gradual and then a rapid increase in mortality in older ages. These observations are consistent at the national level and by province.

The distribution of mortality by sex is expected. The age–specific death rates for males are higher than that of females, especially in the middle to the older ages. Results further reveal that patterns of mortality by population group are mostly consistent with that of the national and provincial patterns. The black African population has higher age–specific death rates followed, by the coloured population. Age–specific death rates are lowest among the white population. The variations in levels by population group and province can possibly be explained by differences in socio-economic status of these populations and also that the deaths were not adjusted. Overall, the spatial and population group mortality pattern observed is consistent with mortality expectations, which suggests high mortality among men, in the poorer geographical areas, and in population groups of lower economic status (UN, 2014). In all, these observed patterns on unadjusted data suggest a plausible mortality dataset, which can be used for the study.

Figure 3 (a–j): Observed age–specific death rates patterns by provinces and sex in South Africa, CRVS 2011–2016






c. Eastern Cape
0,080
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0,000
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5-9
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15-19
20-24
25-29
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40-44
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50-54
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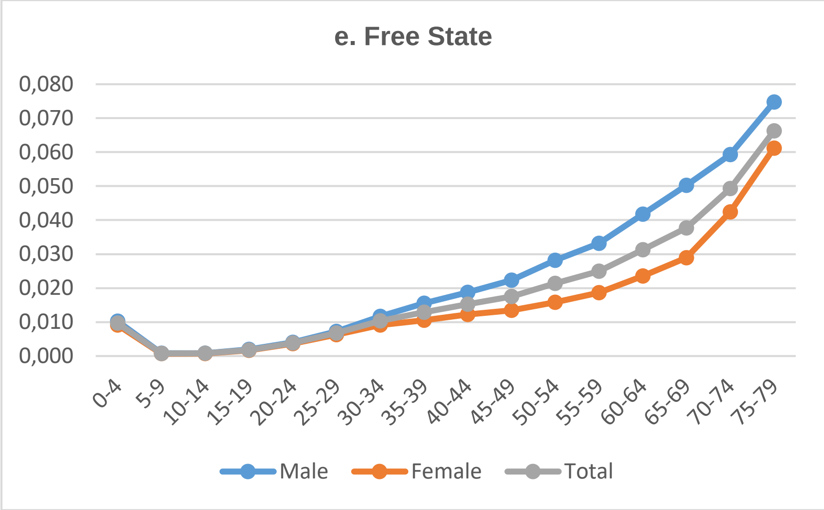
60-64
65-69
70-74
75-79
Male
Female
Total


e. Free State
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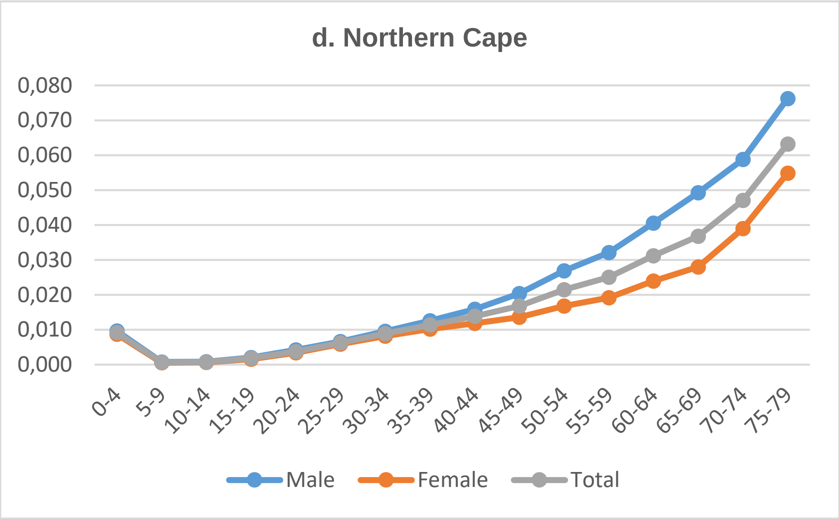
70-74
75-79
Male
Female
Total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25-29
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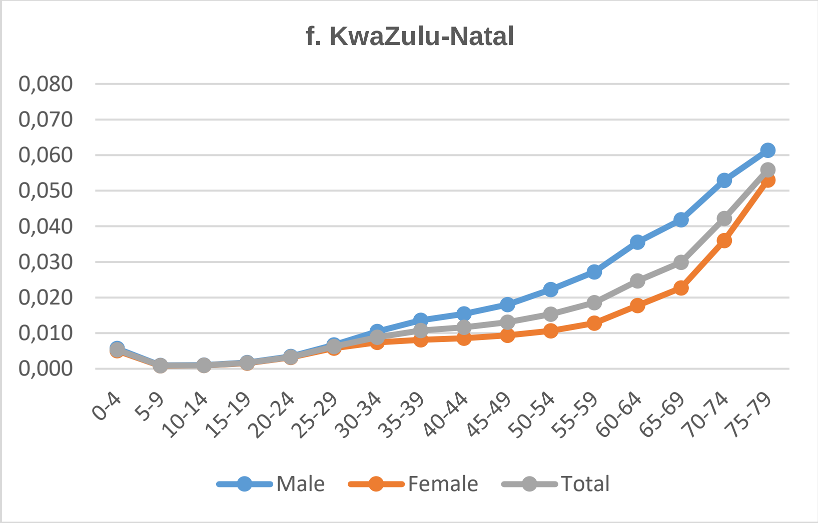
60-64
65-69
70-74
75-79
Male
Female
Total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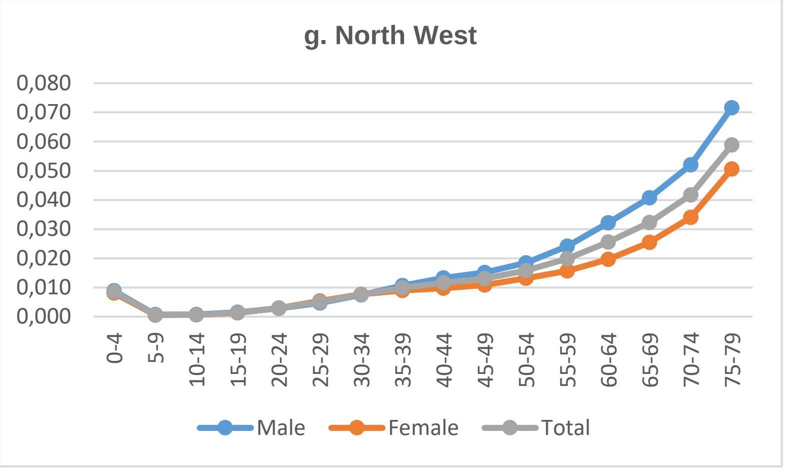
60-64
65-69
70-74
75-79
Male
Female
Total


g. North West
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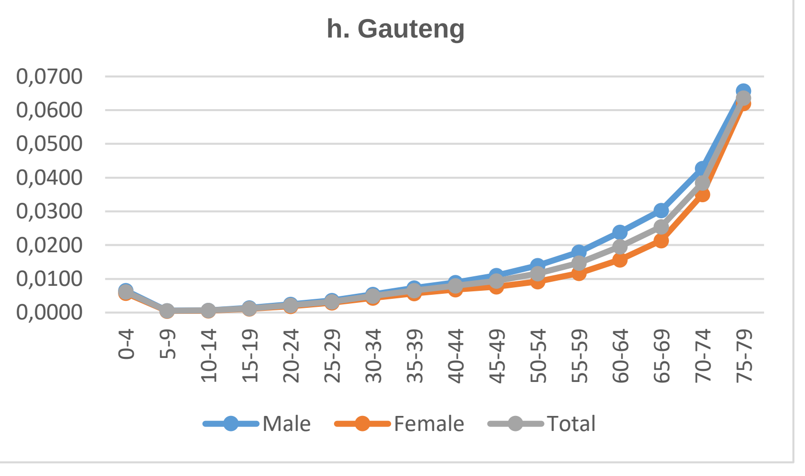
Male Female Total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0,0100
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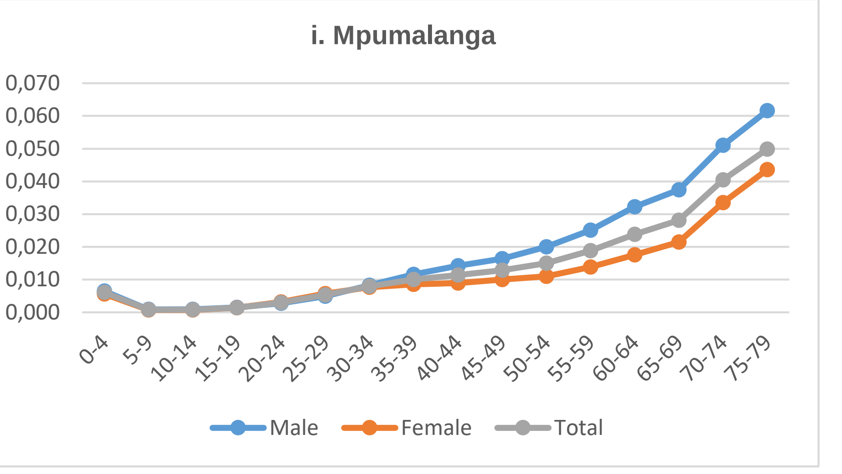
0-4 5-9 10-14 15-19 20-24 25-29 30-34 35-39 40-44 45-49 50-54 55-59 60-64 65-69 70-74 75-79
Male Female Total


i. Mpumalanga
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0,000
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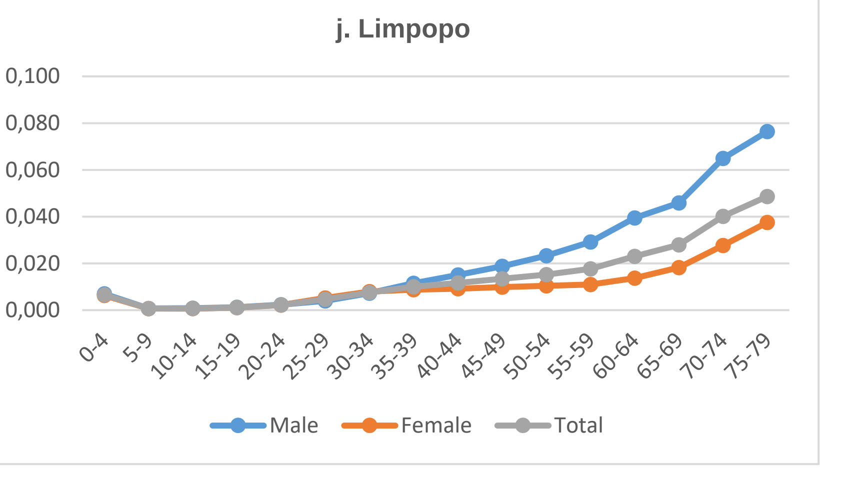
Male Female Total


j. Limpopo
0,100
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0,060
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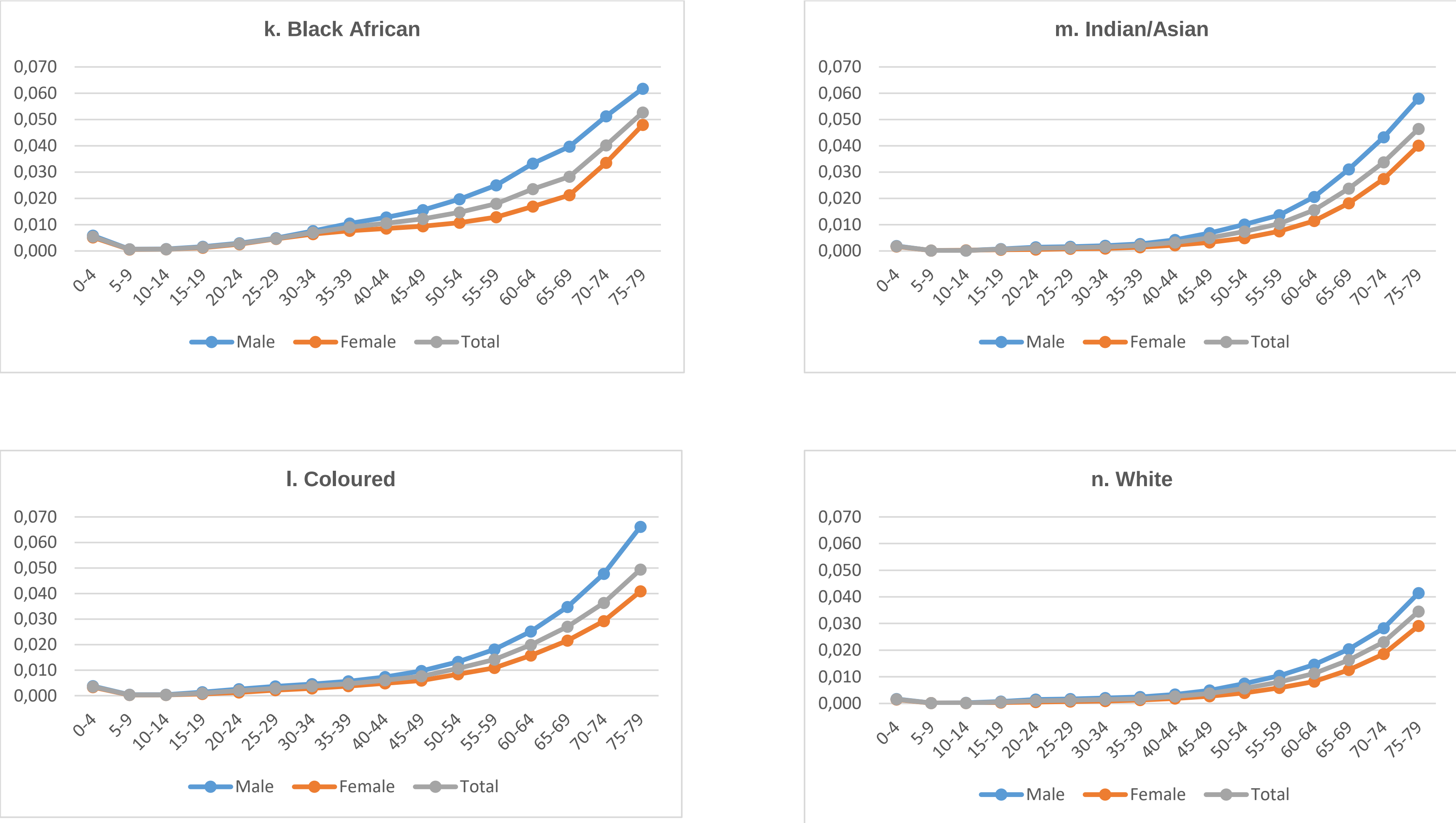
0-4 5-9 10-14 15-19 20-24 25-29 30-34 35-39 40-44 45-49 50-54 55-59 60-64 65-69 70-74 75-79
Male Female Total

Figure 4 (k–n): Observed age–specific death rates patterns by population group and sex in South Africa, CRVS 2011–2016



5. Results

5.1 Percentage deviations from the line of best fit before reducing the impact of errors in the data

The line of best fit is the line that goes through scatter plot points that best expresses the relationship between these points. Table 1 below shows the percentage deviation from the fitted line before reducing the impact of possible errors in the data by age group, province and sex. The results show high values of percentage deviations observed among the male and female population aged 5–29 in provinces such as Western Cape, Eastern Cape and especially among males in the Northern Cape, Free State and KwaZulu-Natal. Percentage deviations continued to be high up to age 30–34 in the provinces of Western Cape and Northern Cape.

The percentage deviations of males were higher than females in provinces such as Western Cape, Northern Cape and Free State among those aged 5–34 years. In contrast, the Limpopo, Mpumalanga and Eastern Cape provinces had higher percentage deviations among females compared to males, especially among the young population. The deviation presented exceptionally high values in the Gauteng province across almost all age groups for both sexes, thus suggesting a high level of divergence from the fitted line in the province. This development may be associated with the significant migration that the province experiences and/or age errors in the reporting of deaths and population in the province. For example, one of the errors of age misreporting is anticipated to be with the elderly population. However, fitted points at elderly ages 75+ show signs of plausible data.

The results by population group (Table 2) show that black African females had the points which lie fairly along the fitted line compared to other population groups. Black African males had higher percentage deviations than females across all age groups. Also, deviations were noticeable in children aged 5–19 across all population groups and sex, except for black African females. Among the white population, the highest deviations reflected in all age groups with the exception of those in the age group 35–44. Deviations were higher among Indian/Asian males aged 35–59, compared to their female counterparts. These patterns of percentage deviations in the tables are affirmed by the presented charts in Appendix 2.

Table 1: Percentage deviations from the line of best fit by age group, province and sex, 2011–2016

Age	Western Cape		Eastern Cape		Northern Cape		Free State		KwaZulu-Natal		North West		Gauteng		Mpumalanga		Limpopo	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
5-9	40,6	-31,5	-107,0	-144,8	86,7	8,1	67,6	-10,6	17,9	-56,2	30,4	-41,7	620,9	247,8	29,5	-40,6	21,2	-42,2
10-14	32,9	-16,3	-59,2	-81,1	60,1	-4,2	45,7	-20,6	30,8	-15,6	4,5	-44,3	508,3	212,3	15,0	-37,1	-5,9	-55,6
15-19	38,0	10,9	-29,4	-35,9	38,7	-4,1	35,0	-10,2	34,9	7,4	4,0	-21,8	332,9	149,6	11,7	-22,4	1,4	-34,4
20-24	45,2	24,8	-19,8	-14,4	33,1	7,8	32,7	1,8	26,9	11,5	14,0	-0,2	225,1	120,1	8,2	-12,3	6,0	-14,6
25-29	42,3	23,3	-11,5	-2,0	28,9	13,3	24,5	4,3	18,6	10,9	13,5	6,5	186,2	104,5	9,1	-3,1	0,4	-8,8
30-34	17,5	1,7	2,8	13,6	18,3	17,4	11,4	9,1	9,1	9,1	1,1	8,6	304,7	77,1	3,4	2,8	-2,0	3,8
35-39	-13,4	-9,7	8,5	22,2	6,3	21,6	-3,9	14,7	0,2	9,4	-15,9	10,7	35,2	-39,6	-6,6	7,4	-6,8	12,6
40-44	-17,2	2,5	6,8	20,8	2,0	23,9	-13,3	15,0	-5,6	10,2	-19,8	10,4	105,2	-23,2	-10,3	12,7	-12,6	13,9
45-49	-12,4	9,1	5,8	17,5	1,7	21,8	-16,7	10,8	-8,7	8,7	-12,7	8,2	201,3	-27,5	-9,3	13,9	-9,5	12,5
50-54	-13,0	4,4	4,4	11,1	-3,1	12,2	-16,4	3,1	-10,5	2,0	-6,7	2,8	1362,1	-58,1	-5,7	11,0	-4,8	7,5
55-59	-14,4	-0,2	4,2	3,2	-14,4	-5,5	-15,5	-7,6	-12,1	-6,6	-3,0	-3,9	-580,7	-103,7	-3,1	2,0	-1,8	1,1
60-64	-14,4	-1,8	7,0	-2,0	-31,6	-37,1	-14,0	-13,9	-12,6	-10,6	2,6	-4,5	-544,4	-114,5	-0,9	-4,6	4,1	-1,8
65-69	-8,4	-7,4	7,6	-3,1	-33,6	-55,1	-7,9	-12,6	-10,3	-10,3	4,3	-1,9	-211,0	-82,6	0,8	-4,3	7,6	-0,4
70-74	-0,6	-9,0	6,6	0,8	-11,1	-28,1	0,4	-1,4	-2,1	-2,3	4,5	3,3	-29,4	-27,5	3,5	0,8	6,3	2,7
75-79	1,4	-2,3	1,8	1,6	1,9	-0,6	3,8	5,4	4,4	3,4	3,7	3,1	6,8	2,8	2,9	2,2	1,4	3,0
80-84	2,4	3,3	-9,1	-6,0	8,8	8,4	2,1	-0,8	2,1	0,4	-4,6	-3,1	8,0	8,9	-2,7	-2,5	-5,5	-5,2

Table 2: Percentage deviations from the line of best fit by age group, population groups and sex, 2011–2016

	Black Africans		Coloured		White		Indian/Asian	
Age group	Male	Female	Male	Female	Male	Female	Male	Female
5-9	141,8	3,8	114,5	56,2	24,4	39,4	-165,2	59,4
10-14	93,1	11,9	83,3	44	24	40,1	-81,3	51,7
15-19	68,9	6,1	53,1	27,6	27,1	44,2	-25,8	51,4
20-24	55,3	1,5	28	3,3	30,1	47,2	0	48,1
25-29	41,6	5,6	-4,7	-36	28,5	45	10,5	34,6
30-34	18,6	2,4	-63	-107	18,7	35,5	13,4	3,8
35-39	-10,1	2,7	-58,9	-73,2	4,3	22	20,5	-8,3
40-44	-22,6	6,5	-10,6	-2	-18,2	-1	22,8	-9,9
45-49	-19,9	7,3	5,5	18,6	-42,7	-34,8	19,4	-16,6
50-54	-17,2	1,3	3,4	14,2	-39,7	-49,8	14,7	-10,7
55-59	-18,1	-8,1	-1	4,2	-26,5	-47,9	8,9	-5,3
60-64	-18,5	-12,4	-4,2	-5,8	-14,7	-40,8	1,4	-2,1
65-69	-13,4	-10,1	-5,6	-12,5	-4,4	-34	-9,9	-1,9
70-74	-1	-0,1	-3,5	-8,2	3,6	-22	-15,2	-3,2
75-79	5,3	5,2	-0,6	0,6	4,7	-5,2	-8	-1
80-84	3	-0,4	3	3,2	-0,9	7,1	4,7	2,3

5.2 Estimations of parameter of completeness of enumeration, 2011–2016

5.2.1 Parameter of completeness of enumeration (k_2) by province, 2011–2016

Table 3 shows the estimates of enumeration (k2) and incompleteness by province, 2011–2016. It provides relative completeness of male and female enumeration in the CS 2016 in comparison to the Census 2011 across provinces. Based on the errors revealed in Tables 1 and 2, the completeness was estimated and age groups were trimmed to reduce the effect of the anomalies on the completed estimates. Generally, with the exception of KwaZulu-Natal and Eastern Cape, the male population had higher incompleteness of enumeration than the female population in 2016 compared to 2011. KwaZulu-Natal was the only province with a higher percentage (5,6%) incompleteness of enumeration among females compared to males (0,5%) in 2016 relative to 2011. The results revealed enumeration completeness levels of 87,4% (male) and 94,3% (female) in CS 2016, relative to Census 2011 in the Gauteng province. This implies that male and female enumeration was 12,6% and 5,7% less complete in the period in Gauteng, indicating a higher incompleteness compared to other provinces. Free State reported a completeness enumeration value (k2) of 92,9% among males and 99,3% among females, suggesting 7,1% and 0,7% less completeness in 2016 compared to 2011. These were followed by Eastern Cape, Mpumalanga and Limpopo with 5,3%, 4,6% and 4,0% less completeness among males and 5,3%, 0,1% and 0,8% less completeness among females, respectively.

Table 3: Estimates of enumeration (k_2) and incompleteness by province, 2011–2016

	Enumeration completeness (k_2)		Incompleteness	
Province	**Male**	**Female**	**Male**	**Female**
Western Cape	98,8	99,0	1,2	1,0
Eastern Cape	94,7	94,7	5,3	5,3
Northern Cape	97,4	98,6	2,6	1,4
Free State	92,9	99,3	7,1	0,7
KwaZulu-Natal	99,5	94,4	0,5	5,6
North West	96,2	100,0	3,8	0,0
Gauteng	87,4	94,3	12,6	5,7
Mpumalanga	95,4	99,9	4,6	0,1
Limpopo	96,0	99,2	4,0	0,8

5.2.2 Parameters of completeness of enumeration by population group (2011–2016)

Table 4 shows the estimates of enumeration (k2) and incompleteness by population group, 2011–2016. It provides the values of the completeness of male and female enumeration in the 2016 census compared to the 2011 census across the population groups. The results show that the male population has a higher value of enumeration completeness compared to the female population among black Africans (96,8%) and whites (99,4%), while at 96,3%, black Africans had the least among females in 2016. Among the coloured, Indian/Asian and white female population, the findings indicate an average value of 99%, implying that female enumeration completeness was about 1% less complete (average) in 2016 compared to 2011. Result among the male population revealed values of 96% and 95,2% among the coloured and Indian/Asian population, signifying that these populations were 4% and 4,8% less enumerated in 2016 relative to 2011, respectively.

Table 4: Estimates of enumeration (k_2) and incompleteness by population group, 2011–2016

Population group	Enumeration completeness (k_2)		Incompleteness	
	Male	Female	Male	Female
Black African	96,8	96,3	3,2	3,7
Coloured	96,0	98,9	4,0	1,1
Indian/Asian	95,2	99,1	4,8	0,9
White	99,4	98,8	0,6	1,2

6. Estimations of completeness of adult death reporting, 2011–2016

6.1 Spatial distribution of estimates by province and sex, 2011–2016

Figures 5 A–D show the spatial distributions of estimated completeness levels of adult death reporting by province and sex, using the GGB and SEG methods in the inter-censal period 2011–2016. With a slight difference in percentage, the result shows that the patterns of reported levels of completeness observed using both methods were almost consistent for both sexes. The results using the GGB method show that the Northern Cape (91%), Gauteng (85%), closely followed by Western Cape (82%) recorded the highest levels of completeness, while the Eastern Cape (51%) and Mpumalanga (53%) reported the least among the male population. Although with slight differences, these patterns were also evident among males using the SEG method, especially in Northern Cape (91%), Gauteng (88%) and Western Cape (80%), respectively. The female population presented almost the same levels with that of the Northern Cape (98%), Gauteng (86%), closely followed by Western Cape (76%) reporting the highest levels of completeness, using the GGB method. Provinces such as Mpumalanga (53%), followed by Limpopo (56%) and Eastern Cape (58%) reported the least in the inter-censal period among the female population using the SEG method.

Figures 5 A–D: Spatial distribution of estimated completeness of adult death reporting in provinces of South Africa (male and female), using the GGB and SEG methods, 2011–2016

Figure A

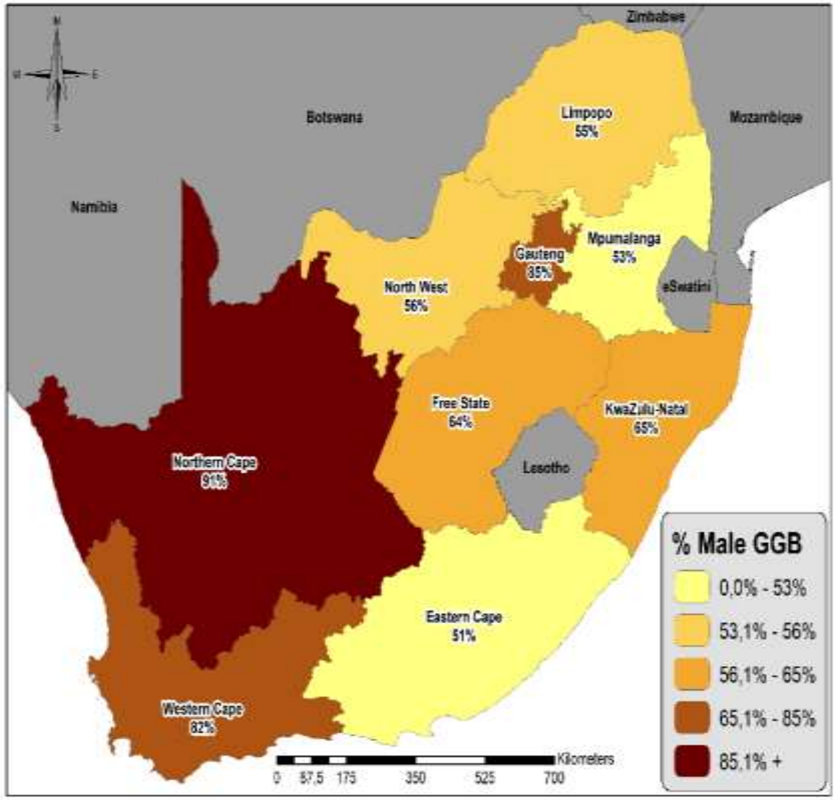


Figure B

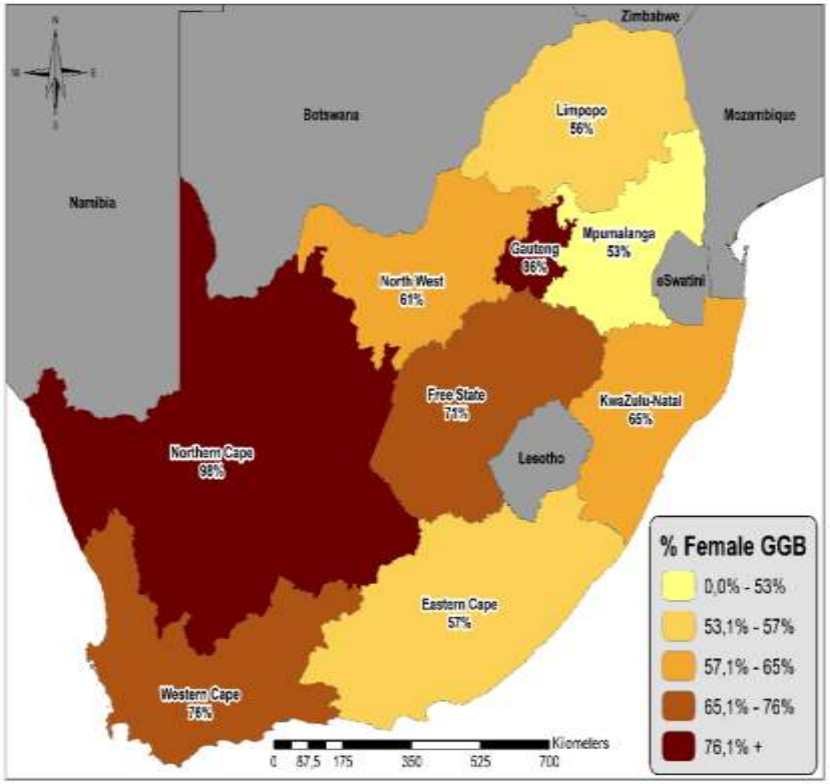


Figure C

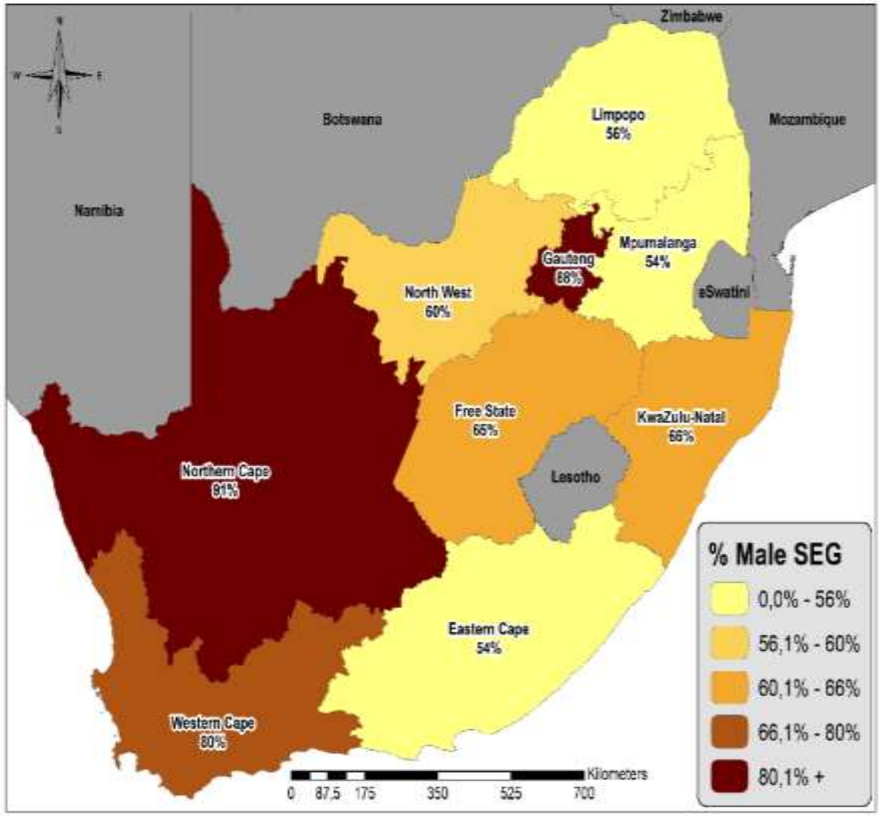
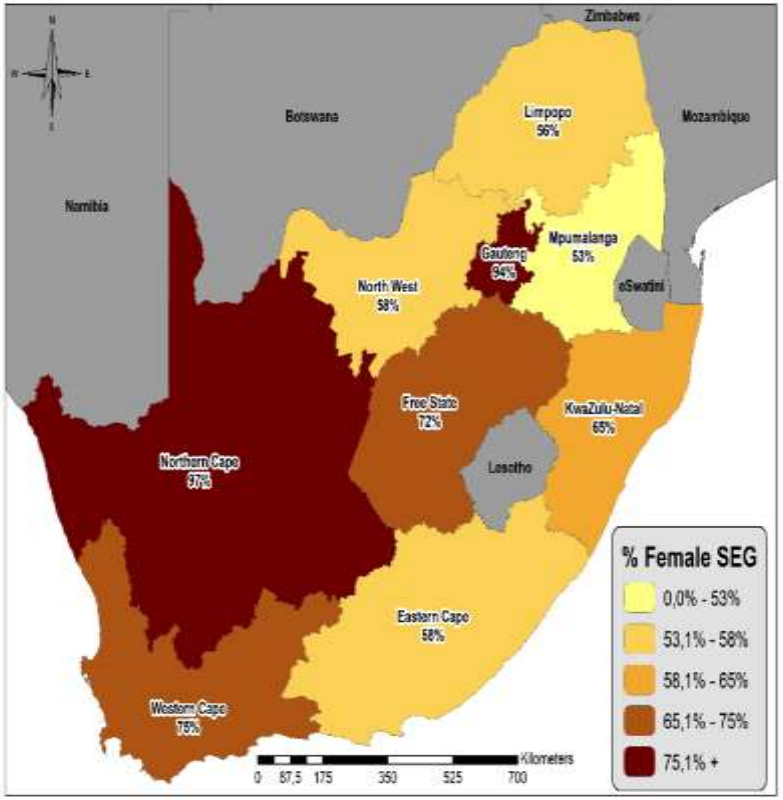


Figure D



6.2 Estimations of completeness by population group and sex, 2011–2016

Table 5 shows the estimates of completeness of adult deaths reporting by population group and sex, using the GGB and SEG methods in the inter-censal period 2011–2016. The results show that the patterns of reported levels of completeness were almost consistent using both methods by sex. The results using the GGB method among males show that the white population (75%) reported the highest completeness levels, while at 60%, Indians/Asians reported the least. However, the levels by female population show that the whites (85%) – closely followed by Indians/Asians (83%) – reported the highest completeness levels, while at 66% black Africans reported the least. The levels using the SEG method among males show that whites (71%) followed by black Africans (66%) reported the highest completeness, while at 60% the Indian/Asian populations reported the least. Among females, the white (83%) followed by the Indian/Asian (79%) population group reported the highest. At the national level, the GGB method reported the same level of completeness at 96%, while the SEG method reported 90% and 94% for the male and female population, respectively.

Table 5: Estimates of completeness of adult deaths reporting by population group and sex, using the GGB and SEG methods, 2011–2016

	Male		**Female**	
	%	**%**	**%**	**%**
Population group	**GGB**	**SEG**	**GGB**	**SEG**
Black African	65	66	66	67
Coloured	*	*	69	66
White	75	71	85	83
Indian/Asian	60	60	83	79
South Africa	96	90	96	94

NB: The national completeness from the study is consistent with that of Stats SA (2021), using the GGB method.
** The estimate of coloured males was not reasonable, suggesting issues of data quality.*

7. Discussions

The study examined the completeness of adult death reporting and their parameters of completeness of enumeration as complements in the inter-censal period 2011–2016 in South Africa by sex, province and population group. In doing this, it also assessed the quality of the data used in the study by looking at the age and sex distribution patterns of the population and the observed age-specific death rates in 2011–2016. These assessments revealed that the distributions of the data used in the study are reasonable to apply in the estimation processes. Earlier studies in South Africa such as Stats SA (2017, 2019 and 2021) have attested to the quality of these data in South Africa.

The review of mortality distributions in the inter-censal period also revealed patterns consistent with national and global expectations. The study showed mortality distribution patterns typically higher among males, less developed provinces and population groups; especially among black Africans. In support of these facts, reports by Stats SA (2015) revealed the male population reporting a higher level of mortality compared to the female population (Stats SA, 2015). Also, the observed higher patterns reported by population group may be associated with the low socio-economic status (conditions) among black Africans, resulting in a higher mortality distribution (De Wet & Odimegwu, 2017; Haal et al., 2018; Stats SA, 2021).

The lower number of deaths among the female population as revealed in the study has also been associated with higher risk of death among males compared to females in South Africa (Stats SA, 2021; Stats SA, 2015). Studies have also shown women have a longer life expectancy compared to men (Stats SA, 2022). In support of these narratives, Stats SA (2015) observed that “there are differences in survival for females and males, with the latter consistently higher although the differences get narrower with time” (Stats SA, 2015:27).

In fitting the GGB model, the study revealed higher percentage deviations from fitting the straight line to the data points among children and youth populations (5–29), which may be associated with issues of migration or age misreporting. Also, the observed substantial differences among this segment of the population may also be caused by proxy reporting in censuses or surveys. For instance, in collecting data, anyone in the household who was 18 years or older was eligible to respond to questions on behalf of other household members (Stats SA, 2012). The results of the percentage deviation suggest that female reporting was reasonable compared to male reporting. These are so, with the exception of the North West province where the female deviations between the ages of 5 and 34 were higher than that of males. The Gauteng province observed points which are divergent from the fitted line in the majority of the age groups. This may also be associated with significant migration experienced in the province and age errors of reporting deaths and population. These patterns are consistent with that of the Census 2011 undercount that recorded 15,9% for males and 13,4% for females in the Post-enumeration Survey (PES) (Stats SA, 2011). In addition to this, the gross undercount was estimated to be 4,3% of the population in 2016 and 3,6% in 2011 (ibid).

Adjustment for errors associated with the effect of net migration, exaggeration of age at death and age misreporting in censuses revealed that Gauteng had the lowest completeness of enumeration among males (87%) and females (94,3%), compared to other provinces. This suggests 12,6% (male) and 5,7% (female) less completeness, and also confirms the highest level of deviations from the fitted lines across all the age groups and provinces. Provincial incompleteness between censuses was higher among males, implying that male enumeration was less complete in 2016 relative to 2011. This also holds for the Indian/Asian male population, which has the lowest level of completeness of enumeration in relation to others.

In using the GGB method and controlling for errors, results of completeness of adult death reporting among the male population show that provinces such as Northern Cape (91%), Gauteng (85%), closely followed by Western Cape (82%) recorded the highest levels of completeness. Provinces such as Eastern Cape (51%) and Mpumalanga (53%) reported the least in the inter-censal period. Presenting almost the same level, these same provinces reported the highest levels of completeness among females, with provinces such as Mpumalanga, Limpopo and Eastern Cape reporting the least. In support of these findings, Dorrington et al. (2004) observed the same pattern of high levels of completeness with provinces such as Western Cape, Northern Cape and Gauteng, and low levels in provinces such as Mpumalanga and Limpopo (Dorrington et al., 2004). Early literature (Moultrie et al., 2013) insists that the low completeness of less than 60% is of great concern as their uncertainty may be large and therefore care should be taken when interpreting such results (Moultrie, 2013). With slight difference in the levels of completeness, the study also revealed that patterns reported using the GGB method were similar with those reported using the SEG method.

The high level of completeness observed in provinces such as Northern Cape, Gauteng and Western Cape may be associated with issues such as modernization, high level of adherence, improved death registration systems and reduced late declaration attributable to these provinces (Garenne et al., 2016; Dorrington et al., 2004). Specifically, completeness of adult death reporting may be higher in the Northern Cape because of issues of certainty and a small and manageable population size, which presents an advantage in terms of management of death registrations and coverage compared to that of other provinces. Among others, Garenne et al. (2016) has associated the controversies surrounding the estimates of completeness of death registration to uncertainty about the size of the population. Although, earlier studies argue that in small populations, the estimated rates generally have extreme values, i.e. large variability in the estimated rates that do not reflect the true level of heterogeneity of the geographic location (Assunção et al., 2005; Bernadinelli & Montomoli, 1992).

More so, a closer observation reveals that these findings are also logical as higher levels of completeness are naturally expected in highly metropolised provinces such as Gauteng and Western Cape. However, Udjo (2017) in examining early results from Stats SA observed that provincial patterns of completeness of death registration in South Africa are inconsistent (Udjo, 2017). In analysing estimates produced by various statistical agencies with those produced by early studies for the years 1980 and 2010, Queiroz et al. (2020) has also acknowledged the existence of substantial differences in completeness of death estimates that affect both geographical levels and trends in various countries (Queiroz et al., 2020).

The results using the GGB method among men show that the white population (75%) reported the highest completeness levels, while at 60% Indians/Asians reported the least. The levels by female population show that the white population (85%) reported the highest completeness levels of adult death reporting, while at 66% black Africans reported the least. Also, patterns obtained using the GGB method were almost consistent using the SEG method for both sexes. Although commendable, these levels revealed inconsistencies in completeness derived by population group, compared to those derived for the country. This development has been associated with respondents not recording their population group on the death certificate during registration of deaths (Dorrington et al., 2004). This suggests that completeness has not fully improved by population group in the country; a development that is a cause for concern and calls for further research.

Early reports in South Africa (Dorrington, 2013; Dorrington et al., 2004) recommend a comparison of male results with that of females, and the SEG results with that of GGB as a first and second check of validations. They also recommend that estimates obtained using these methods be compared with those of the country's previous estimates or international institution such as the World Population Prospects (Dorrington, 2013; Dorrington et al., 2004; UN Population Division, 2011). These are so, with the expectation of similarity in the derived estimates (Dorrington, 2013). Results from the study indicate that the levels of completeness among the male population speaks to that of the female population, and completeness levels using both methods are also similar. They are consistent with that of previous estimates in the country as well. Therefore, validates the correctness of the estimates derived in the study.

At the national level, the GGB method reported the same percentage at 96% for both sexes, while the SEG method reported a percentage of 90% and 94% for the male and female population, respectively. The result suggests consistency with that of Stats SA (2021), using the GGB method. These findings further support the understanding that the SEG and GGB methods produce almost the same values, given the correct application of the assumptions and conditions (ibid). In support of this narrative, Chisumpa (2018) in a study in Zambia – using both methods – wrote that "adult mortality estimates derived from these methods are not always exactly the same in magnitude, but will be within acceptable limits of each other if the methods are applied correctly and the assumptions are satisfied" (Chisumpa, 2018:68).

These results are also consistent as they are in line with the patterns of Dorrington (2013) and Stats SA (2021) who observed modestly high and similar levels of completeness, especially at the national level. They are also consistent with Udjo (2017) who acknowledged a high but modest increase and wrote that trends in the levels of completeness of death registration in South Africa should increase and probably be close to 100% (Udjo, 2017). Overall, findings from the study suggest that the completeness of adult death reporting is high and improving in South Africa.

8. Study issues and limitations

Estimating reliable international net migration was a challenge, and as such a limitation in the study. The study also experienced issues of large uncertainties in some provinces and population groups, where completeness appears to be less than 60% and should therefore be interpreted with caution. The developments is also a concern, which calls for more research, especially by population group. The use of census and survey as two points of inter-censal periods also presents a concern in the study due to methodological issues.

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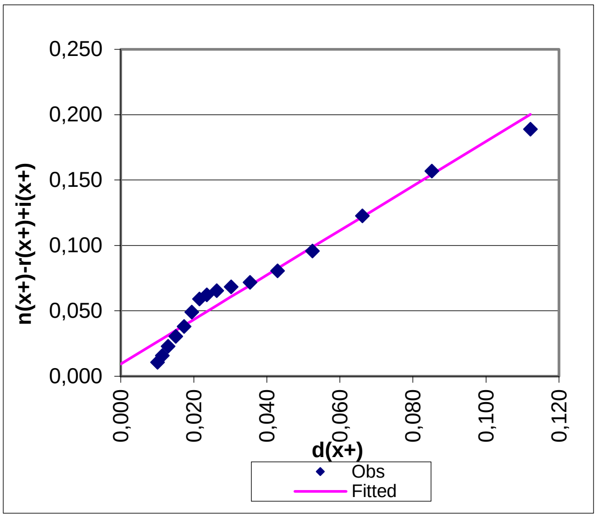
Appendix 1

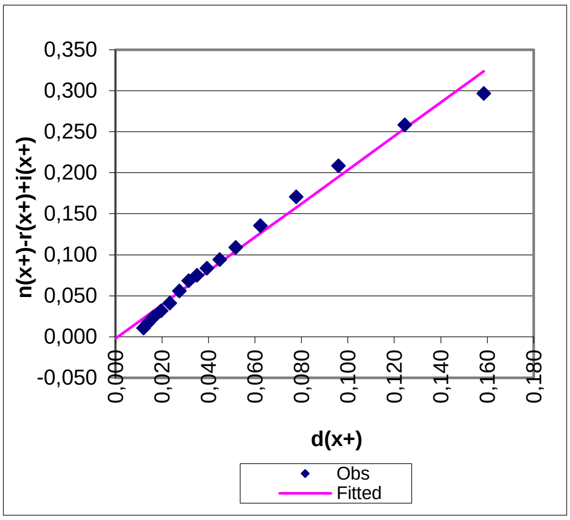
Figures i–x: Fitting the GGB method to official mortality data by provinces and sex in South Africa, 2011–2016

i. Eastern Cape province

Females

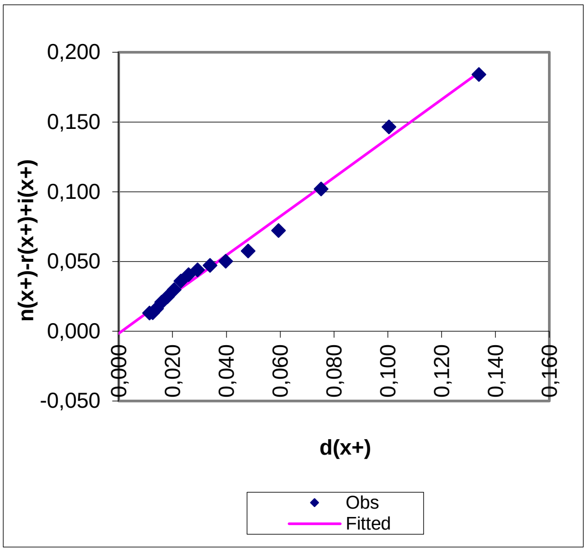


Males



ii. Free State province

Females



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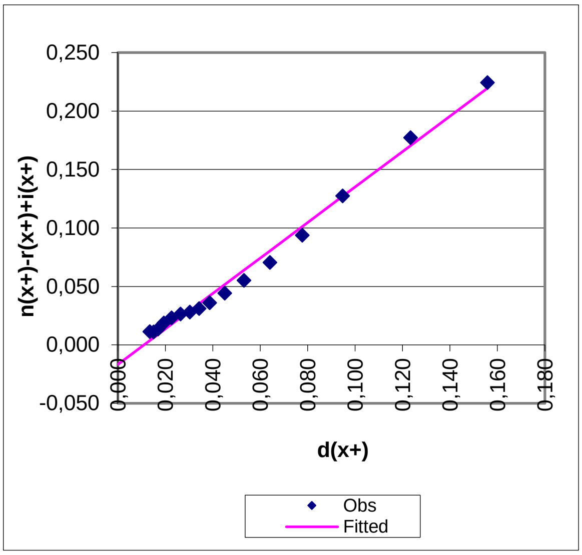
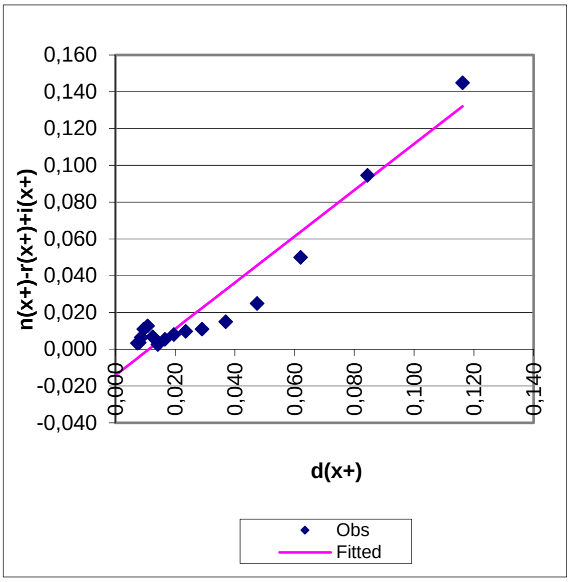
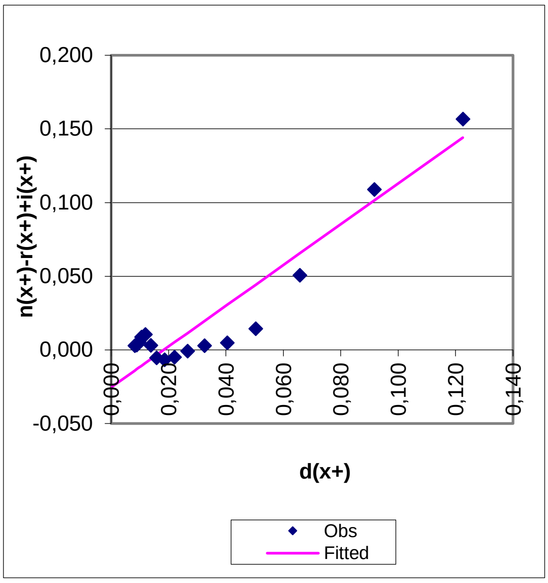


iii. Gauteng province

Females

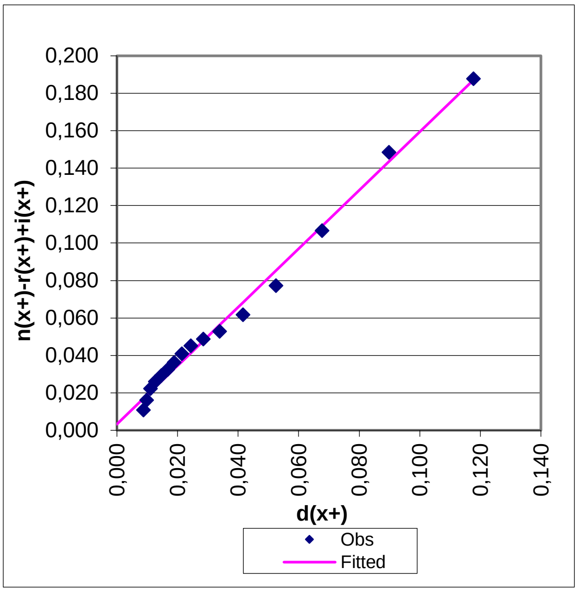


Males

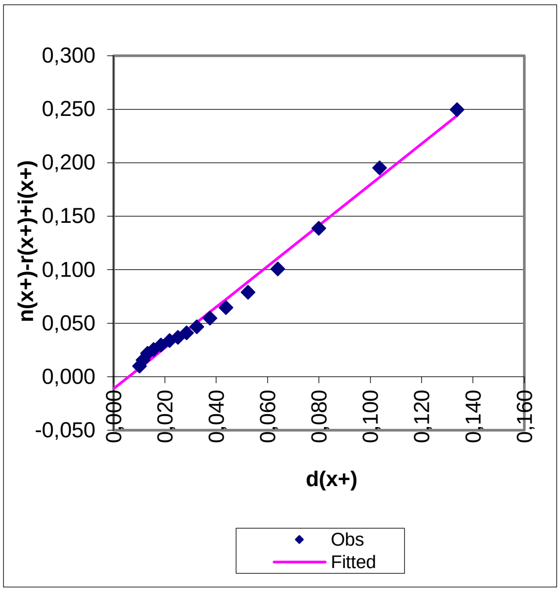


iv. KwaZulu-Natal province

Females

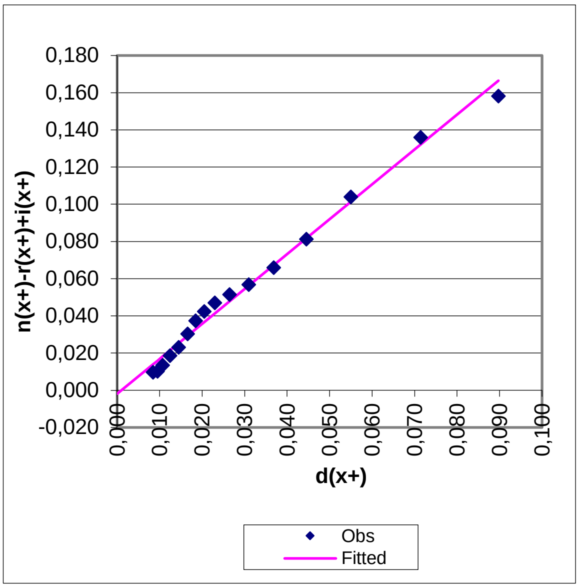


Males

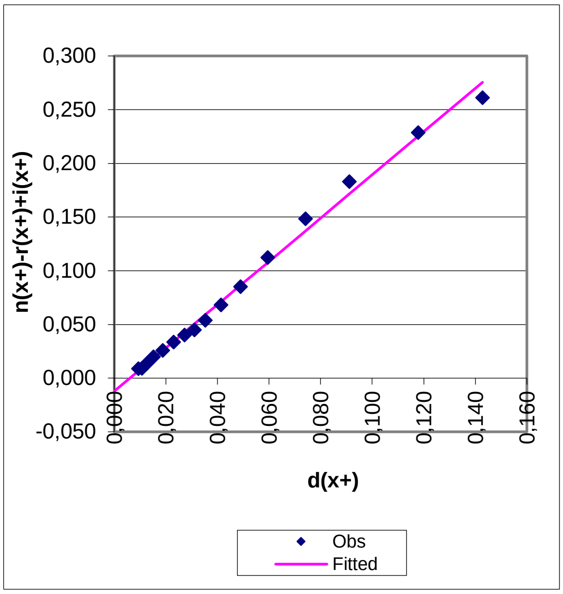


v. Limpopo province

Females

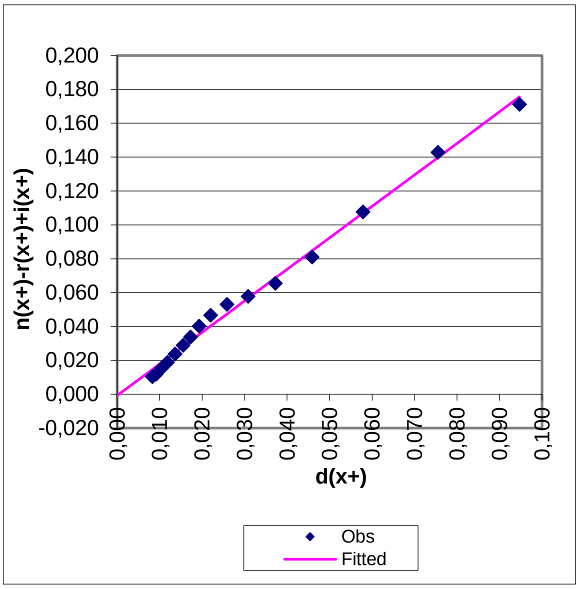


Males

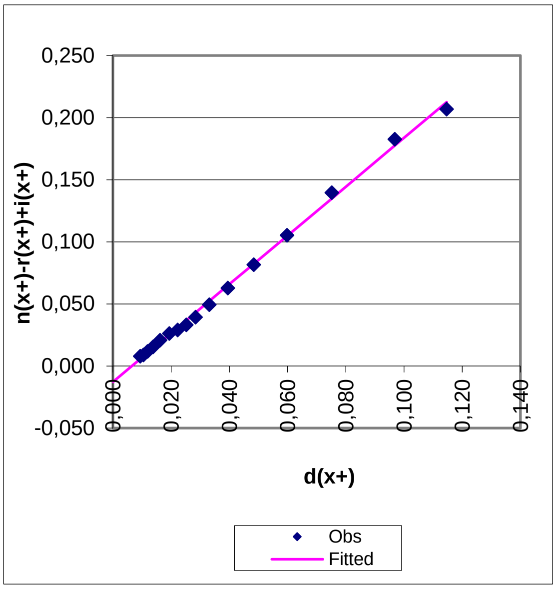


vi. Mpumalanga province

Females

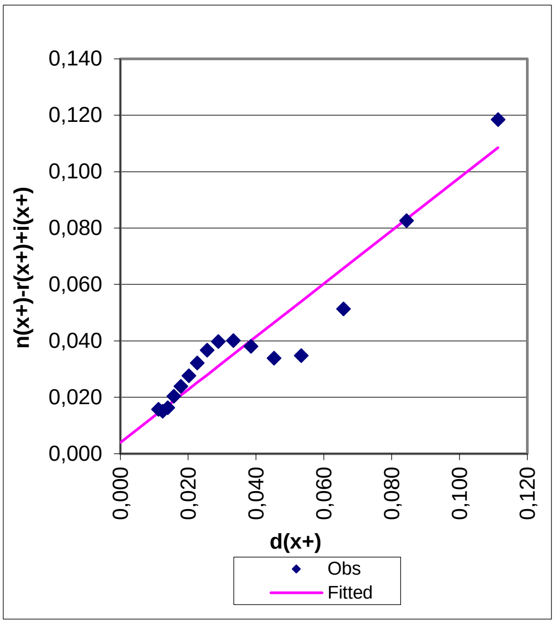


Males

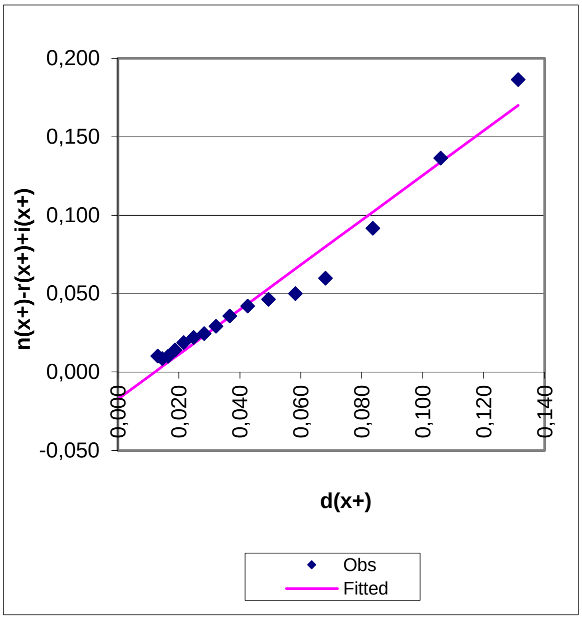


vii. Northern Cape province

Females

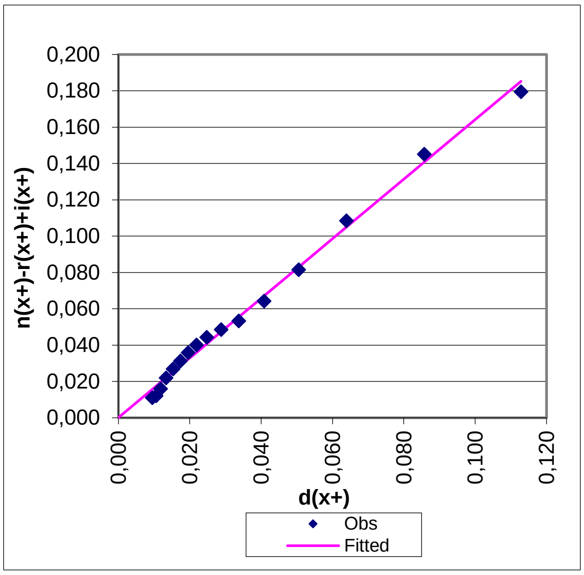


Males

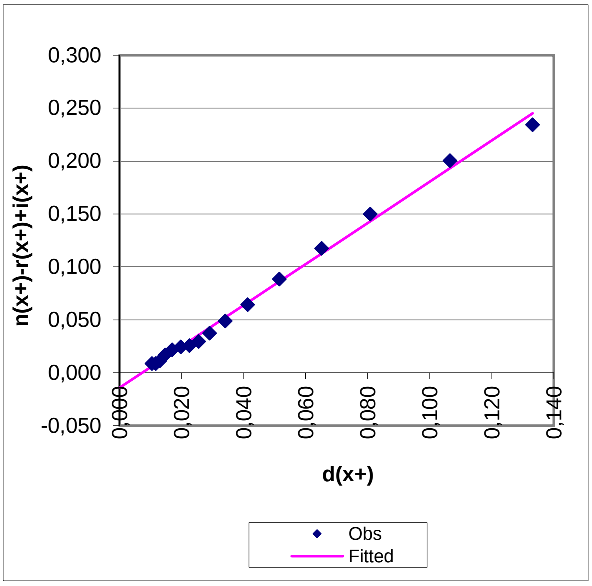


viii. North West province

Females

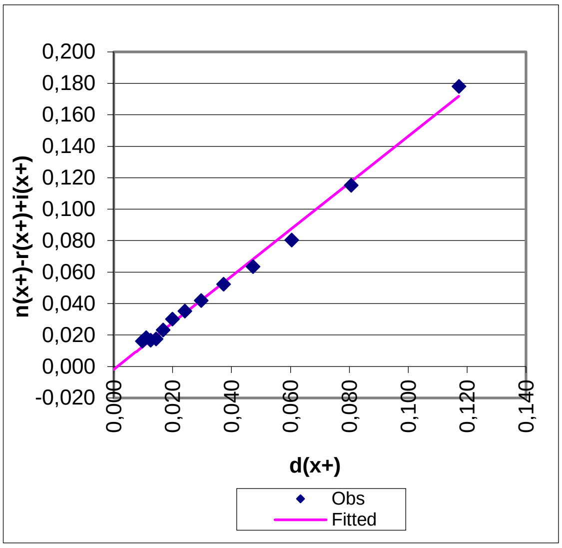


Males



ix. Western Cape province

Females



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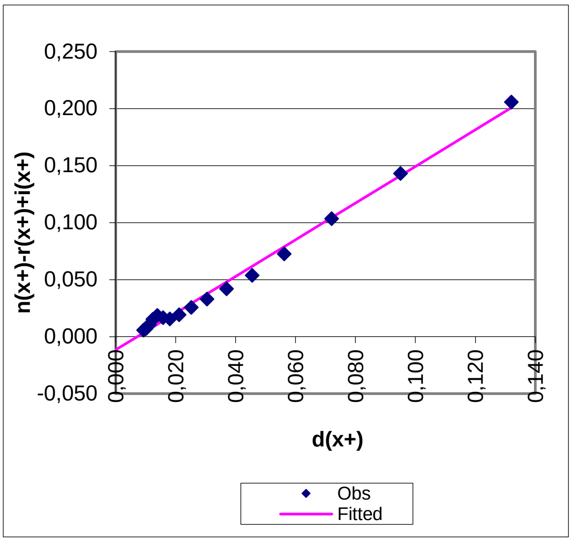
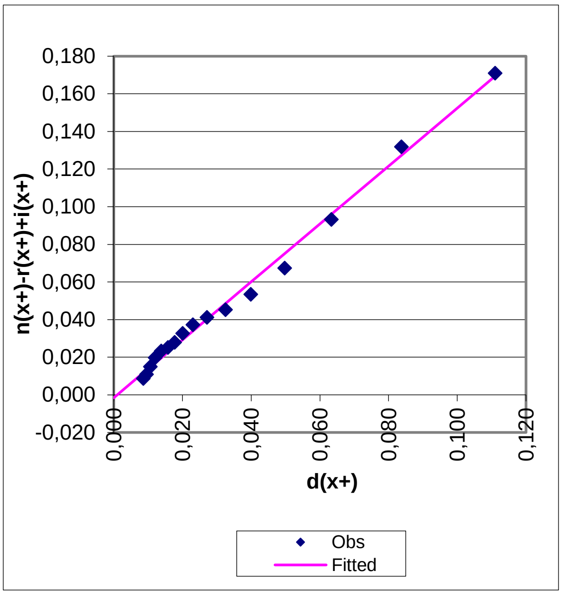


x. South Africa

Females



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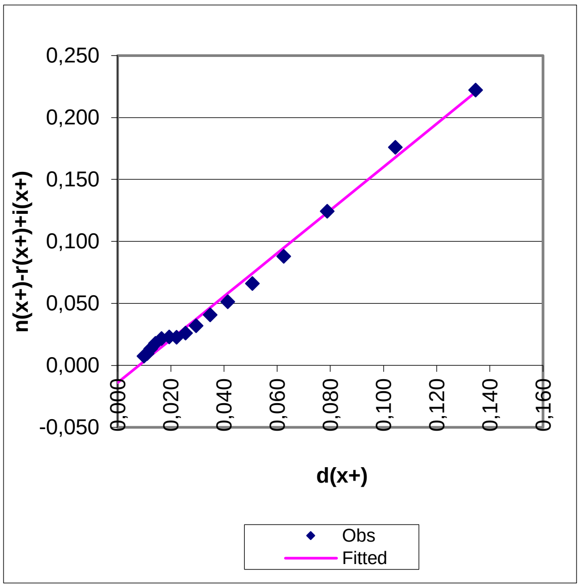
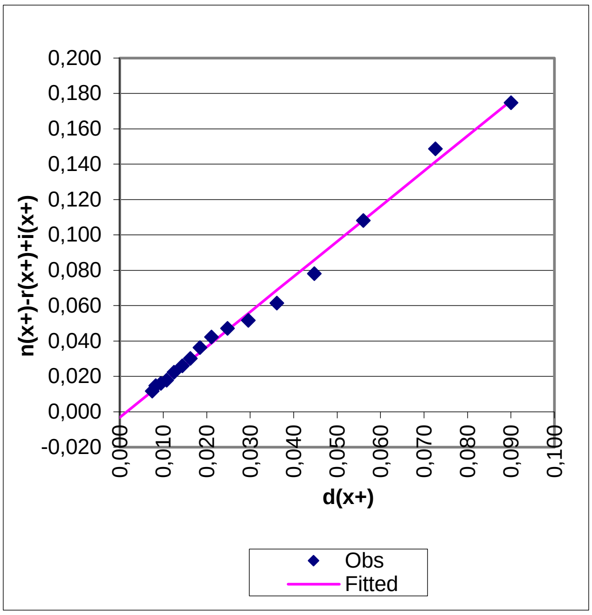


Appendix 2

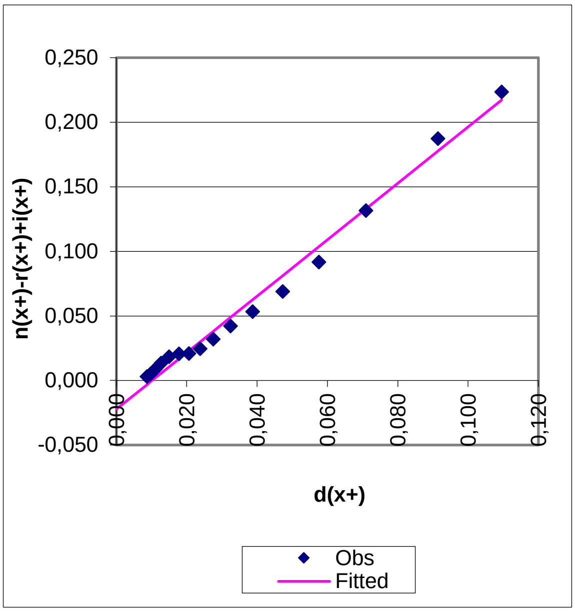
Figures xi–xiv: Fitting the GGB method to official mortality data by population group and sex in South Africa, 2011–2016

xi. Black African

Females

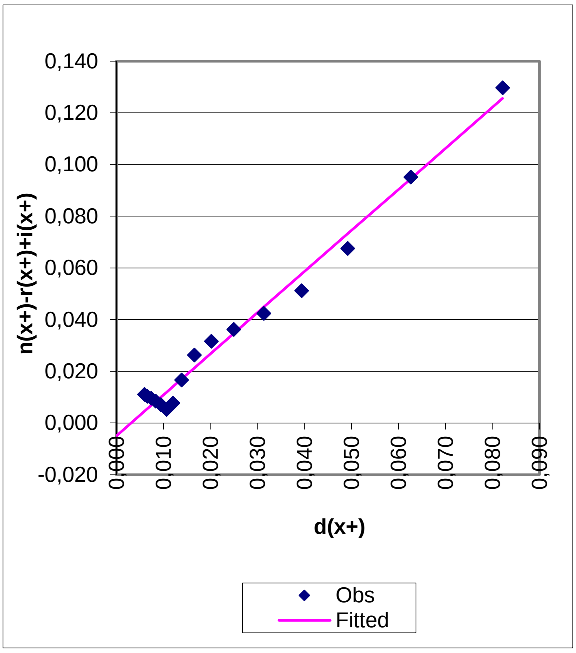


Males

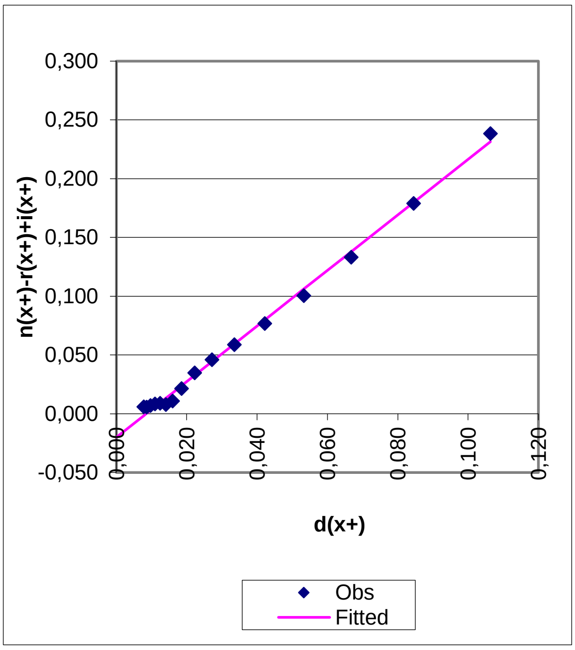


xii. Coloured

Females

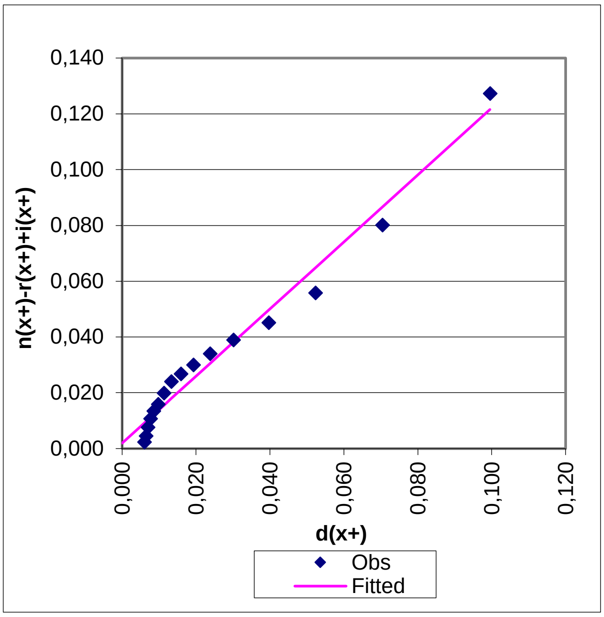


Males

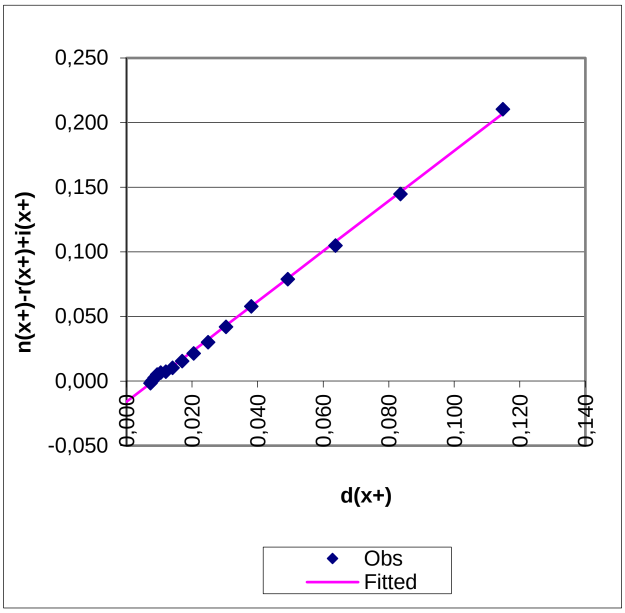


xiii. Indian/Asian

Females

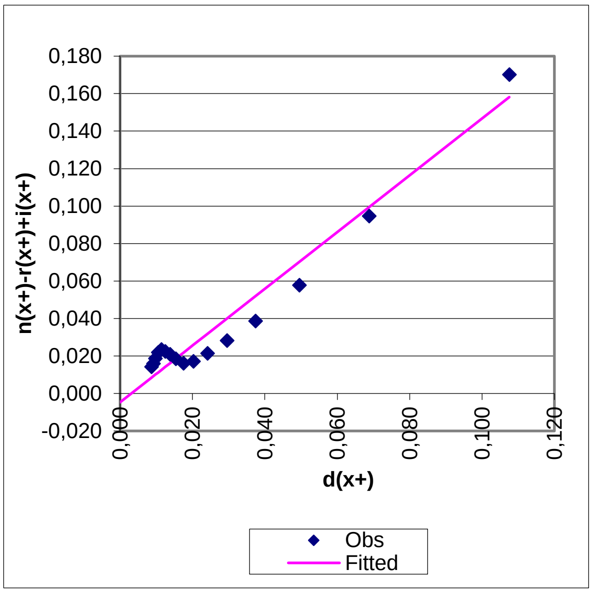


Males

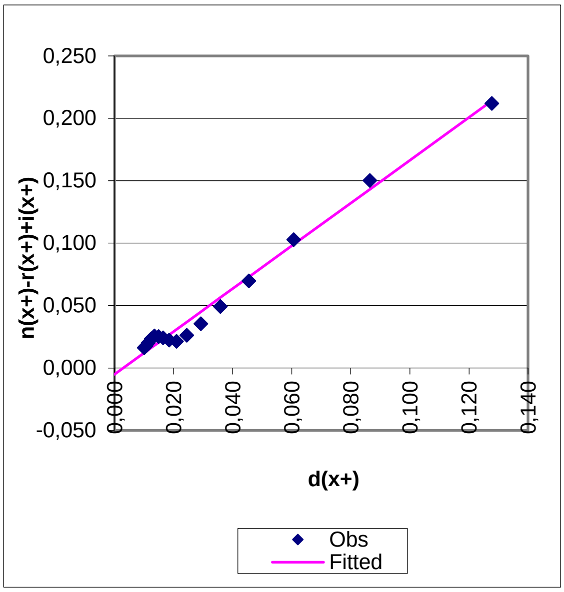


xiv. White

Females



Males



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