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Disparities in quality of life by race, gender, and sexual orientation: An intersectional analysis of population-representative data in Gauteng, South Africa

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ABSTRACT

Background: South Africa's history of apartheid has led to persistent inequalities. While progress has been made since 1994, disparities in quality of life (QoL) remain, particularly along racial lines. This study examines how race, gender, and sexual orientation intersect to influence QoL in Gauteng - South Africa's most populous and economically vibrant province.

Methods: Using data from the Gauteng City-Region Observatory's QoL 6 (2020/2021) Survey, we analyzed a sample of 10,760 respondents. We employed inverse probability weighting with regression adjustment (IPWRA) to estimate the Average Treatment Effect (ATE) of race, gender, and sexual minority status on QoL, while controlling for socioeconomic factors.

Results: Significant QoL disparities were observed across intersecting identities. White heterosexual men had the highest QoL scores, while Black sexual minority women had the lowest. After adjusting for covariates, all Black groups exhibited significantly lower QoL scores compared to their White counterparts. The largest gap was between White sexual minority women and Black sexual minority men (ATE: -14.47; 95%CI: -17.18,-11.76). Within the Black population, heterosexual men had significantly higher QoL than heterosexual women (ATE: -0.98; 95%CI: -1.54, −0.42).

Conclusions: Despite progress since apartheid, substantial QoL disparities persist in Gauteng, primarily along racial lines, particularly in access to services and socio-economic opportunities. The intersectionality of race, gender, and sexual orientation creates distinct vulnerabilities, particularly for Black sexual minority women. These findings suggest that current policies aimed at improving equity may be insufficient. Addressing these disparities requires a multifaceted approach that considers the complex interplay of race, gender, and sexual orientation in shaping QoL.

1. Introduction

Quality of Life (QoL) provides a comprehensive evaluation of overall well-being at individual, household, and population levels (Mizobuchi, 2014; Møller, 2007; Naidoo and de Kadt, 2021; Smale and Hilbrecht, 2016). When used at a population level, QoL can provide a more holistic, person-centered perspective that surpasses single-aspect measures of economic well-being (e.g., Gross Domestic Product [GDP] per capita) or health (e.g., average lifespan). Although there is no universally accepted definition of QoL, the most widely used measures are multidimensional, capturing complex, often subjective, facets of well-being, including physical health, mental state, autonomy, social connections, and environmental interactions (Smale and Hilbrecht, 2016; Bleys, 2012; The Whoqol Group, 1998). At a societal level, monitoring QoL can highlight

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trends in living conditions and inequalities between groups, offering a more holistic approach to guiding public policy and the prioritization of resources than single-issue indicators (Smale and Hilbrecht, 2016; Bleys, 2012). Furthermore, the comparison of QoL between countries allows for the creation of specific benchmarks for living standards and provides an impetus to direct global development efforts toward effective determinants of QoL (The Whoqol Group, 1998; The Organisation for Economic Co-operation and Development [OECD], 2011).

Understanding how QoL varies *within* a population is critical, as this helps identify broad inequities and disparities in a more intersectional manner than a collection of discrete economic and social indicators. Given South Africa's historical context, recent transition to democracy, and the progressive constitution towards sexual and gender diversity, understanding how QoL varies along the axes of race, gender, and sexual orientation, can provide vital information regarding how the country is progressing toward the equitable ideals laid out in the 1996 Constitution (Constitution of the Republic of, 1997). Before 1994, South Africa adhered to a policy of Apartheid, a scheme of institutionalized segregation along racial lines that violently enforced societal stratification and resulted in severe inequalities between Black, Coloured (i.e., mixed-race), Indian (i.e., those of South Asian descent) and White South Africans (The United Nations, 2023). During Apartheid, the primary policy of "divide and rule" sought to sustain white dominance and survival by fragmenting the non-White population along racial lines (Henrard, 2002). While the formal infrastructure of Apartheid has been disbanded and significant progress toward Black, Coloured, and Indian/Asian empowerment has been made since 1994 (Statistics South Africa, 2022a), significant social and economic disparities persist (Sulla et al., 2022).

QoL research has had a long history in South Africa, and the earlier work documented contrasting hopes and fears of Black and White South Africans (Hanf et al., 1981). The disparities in QoL between Black and White South Africans remain considerable and continue to be an active and ongoing area of research (Møller, 2007). National statistics from 2022 reveal stark racial disparities in South Africa's labor market, with the unemployment rate for Black South Africans (35.7%) over four times higher than that of White South Africans (7.8%) (Statistics South Africa, 2022b). Furthermore, while precarious labor forms a substantial and persistent portion of employment across the country (Statistics South Africa, 2022b), its effects are disproportionately borne by Black South Africans, who comprise just over 80% of the population (Statistics South Africa, 2024). A 2022 study found that precarious labor significantly increased the likelihood of household energy poverty (inability to pay for modern energy sources like electricity or liquified natural gas for lighting and cooking), with the effect nearly twice as strong among Black respondents (51.7 percentage points) compared to non-Black respondents (28.3 percentage points) (Koomson and Awaworyi, 2022). In education, a 2007 study found that schools with predominantly Black students (>70%) had a 43% graduation rate, compared to 97.3% in predominantly White schools (Van Der Berg, 2007). Such disparities underscore even greater inequities in the *quality* of this education: data from 2019 shows 14% of Black Africans are functionally illiterate compared to only 0.3% of White South Africans (Khuluvhe, 2021).

Gender equality remains a key national priority (National Planning Commission, 2012; Statistics South Africa, 2023) as considerable work is still needed in many areas, most notably in the labor market where gender disparities continue to mirror racial disparities (Statistics South Africa, 2022b; Koomson and Awaworyi, 2022). This issue is particularly pronounced in the rising precarity of labor conditions, which disproportionately affects women more than men (Mhlana, 2023; Modiba and Mkhize, 2022). For example, a study by Ndinda and Ngandu (2016) highlights that over 60% of employed women work in positions below their qualifications, compared to fewer than 40% of employed men.

An important component of QoL is a person's rating of their own physical and mental well-being, and the evidence here suggests these ratings reveal disparities by both race and gender. More than 50% of Black respondents to a nationally representative survey of 7300 households reported feeling neutral to very dissatisfied with their lives, compared to less than 20% of White respondents (Ebrahim et al., 2013). Within race groups, the same study found that Black women had significantly lower life satisfaction compared to Black men, but there were no significant gender differences in life satisfaction among other racial groups (i.e., White, Coloured, or Indian/Asian). Taken together, previous studies and national statistics suggest substantial disparities in labor, education, and subjective well-being along racial and gender lines in South Africa, which in turn contribute to disparities in QoL. While race and the legacy of Apartheid are crucial factors for these disparities, a more nuanced, intersectional approach to understanding how multiple aspects of societal marginalization may impact QoL in the South African context may reveal points of intervention for specific sub-groups that can serve to reduce these inequities.

Research from high-income countries suggests QoL disparities also exist along the axes of sexual orientation, even in contexts where protections for these identities have been enshrined in law. For example, Barcelona, Spain is considered one of the most welcoming cities for sexual and gender minority (SGM) individuals globally (Kohut, 2013). However, a 2018 study reported that these populations in Barcelona had significantly worse QoL than their heterosexual, cisgender counterparts, with chronic conditions, health-related behaviors (e.g., help-seeking, substance use), and gender playing a major role in these differences (Marti-Pastor et al., 2018). Hsieh and Ruther (2016) also found similar results in a representative sample in the United States, with bisexual women being at elevated risk for poor QoL. The authors emphasize the need to contextualize these health disparities within the intersection of sexual orientation, gender, and race, as controlling for these identities in a simple additive manner failed to predict these disparities. While there are no studies quantifying how QoL in South Africa differs by sexual orientation (hence the need for current study), it is well-documented that discrimination against SGM individuals remains a persistent issue (Nyeck et al., 2019; Sithole, 2015). This is despite the fact that discrimination on the grounds of sexual orientation is explicitly prohibited by the 1996 constitution of South Africa (Constitution of the Republic of, 1997). Qualitative studies suggest sexual minority individuals experience significant barriers to healthcare access (Mkhize and Maharaj, 2020; Nel and Judge, 2008) and employment (Nel and Judge, 2008), however, there is limited quantitative data regarding how QoL writ large may differ among sexual minority individuals in South Africa (van Heerden, 2023), and even less research explores the disparities in QoL across the intersections of gender, sexual orientation, and race within the country.

As alluded to above, an intersectional framework may help elucidate how various social identities interact and shape QoL in South Africa. Originally conceptualized as a legal framework to explain the unique experiences of Black women in the United States, intersectionality theory has been expanded to examine how any individual's minoritized social and political identities interact to create unique and compounded experiences of discrimination and oppression that cannot be fully understood or addressed by analyzing each identity separately (Crenshaw, 1989, 1991). Bowleg and colleagues (Bowleg, 2008, 2012, 2013) were among those who first applied this framework to the interdependent and mutually constitutive nature of race, gender, and sexual orientation among Black gay and lesbian individuals in the United States. Although this framework has been used in qualitative studies (Groenmeyer, 2011; Moolman, 2013) in South Africa, its application in quantitative research in low- and middle-income settings generally (and South Africa specifically) remains limited. Given South Africa's unique history of progressive policies toward SGM people, coupled with a legacy of enforced racial segregation, examining how race, gender, and sexual orientation intersect to affect QoL may highlight the unique challenges faced by specific (e.g., Black, male gay, White, heterosexual female) communities.

Using a QoL measure to assess disparities by race, gender, and sexual

orientation in a South African context provides a timely and unique opportunity to understand how these intersectional markers create layered experiences of privilege and marginalization today. Furthermore, as aforementioned, QoL measures are inherently multidimensional, encompassing a wide range of dimensions that, when combined, offer a comprehensive score and summary of how individuals perceive their lives, based on both subjective and objective indicators. This multidimensional approach enables us to move beyond a single-axis analysis, allowing for the exploration of how the interplay of dimensions across multiple identities can amplify privilege or disadvantage. Such an intersectional approach could enable policymakers and researchers to tailor health, economic, and social policies and interventions (respectively) to mitigate health and social inequities in specific sectors of South African society.

This study aims to be among the first to examine how three axes: gender, sexual orientation, and race, influence QoL in Gauteng–South Africa's most populous, diverse, and economically vibrant province. Utilizing data from a population-representative study, we seek to provide empirical evidence on the extent of QoL differences by race, gender, sexual orientation, and the combination of these factors (Greyling, 2013). Specifically, we hypothesize that Black sexual minority individuals of any gender will report lower QoL compared to their White, cisgender, and heterosexual counterparts and that sexual minority individuals of any race will report lower QoL than heterosexual people in their own racial category. By conducting quantitative analyses in a theory-informed, intersectional way, we aim for this research to offer insights that can help policymakers and researchers develop targeted interventions to enhance QoL across the diversity of South African society.

2. Methods

2.1. Study sample

This present study is a cross-sectional analysis of data obtained from the Quality of Life 6 (2020/2021) Survey, a survey led by the Gauteng City-Region Observatory (GCRO) (de Kadt et al., 2021). The QoL Survey has been conducted every two to three years since 2009 and includes all 529 administrative units (wards) within the province of Gauteng. The province is home to South Africa's largest urban centers, Johannesburg and Pretoria, and is the country's most densely populated province. It encompasses inner-city, suburban, and industrial areas, as well as rapidly growing informal and peri-urban settlements (Statistics South Africa, 2022a). Fig. 1 provides an overview of the Gauteng region, with interview locations highlighted. GCRO's QoL 6 (2020/21) survey, conducted between October 2020 and May 2021, interviewed 13,616 adults aged 18 and older across all wards in Gauteng using a multistage stratified cluster sampling design to ensure representativeness of the study sample to the wider province of Gauteng (Hamann and de Kadt, 2021). In total, at least 20 interviews were conducted in each ward, and a minimum sample of 600 interviews per municipality was required to ensure relatively precise municipal-level estimates. Data collected was weighted by population size, race, and sex to ensure representative estimates at the ward, municipal, and provincial levels (Naidoo and de Kadt, 2021).

All study materials were translated into nine local languages, and respondents were interviewed in the language of their choice. Main interviews were conducted in person by trained fieldworkers following verbal informed consent. An additional self-complete section on gender identity, sexual/romantic attraction, and experiences of violence was included for the first time in QoL 6 (2020/21) survey. Of the original 13,616 respondents who consented to the main fieldworker-administered questionnaire, our study sample consists of N = 10,760

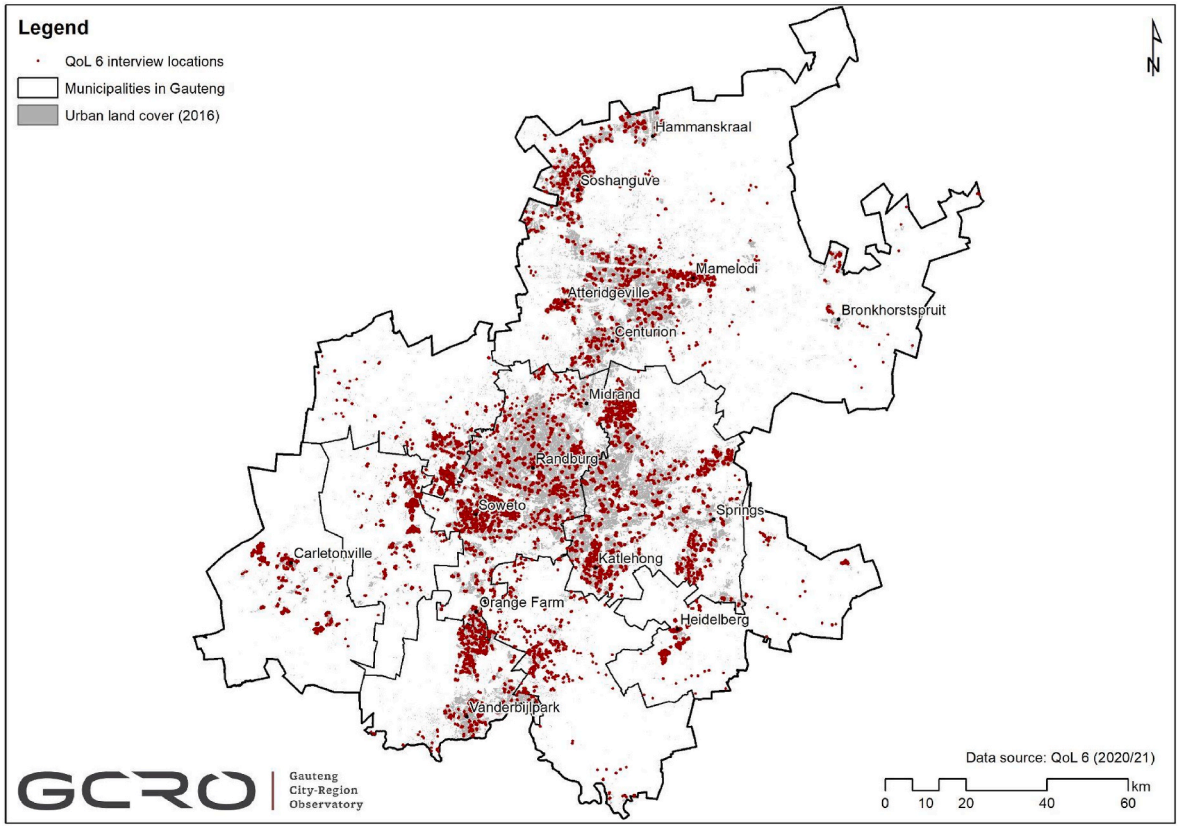


Fig. 1. Map of the province of Gauteng and quality of life 6 (2020/2021) survey interview locations (Map Credited to Christian Hamann).

respondents who provided valid responses to each question regarding race, gender, and attraction. Ethical approval for this survey was secured from the Human Research Ethics Committee of the University of the Witwatersrand, Johannesburg.

2.2. Measures

The primary outcome of interest in this study is QoL assessed through an index developed by the GCRO (Naidoo and de Kadt, 2021). GCRO's QoL index provides a comprehensive tool to understand the subjective and objective well-being as experienced by the residents of Gauteng. Many well-being and progress measures primarily rely on indicators reflecting material conditions and often only address well-being at the provincial or national level. In contrast, the GCRO's QoL Index takes a different approach by using the rich, large-scale, individual-level data generated by the GCRO's QoL Surveys. Calculated at an individual level, this multidimensional index combines variables reflecting material living conditions along with the variables reflecting the perceptions and experiences of the individual respondent (Naidoo and de Kadt, 2021). It incorporates 33 different variables, grouped into seven dimensions (Services, Socioeconomic status, Government satisfaction, Life satisfaction, Health, Safety, and Participation). Each dimension receives a score out of 100, providing insights into various aspects of life in Gauteng. These seven dimension scores are then combined to produce a single composite score out of 100, measuring the overall QoL in Gauteng. This index has been validated as an effective tool for measuring QoL within the province of Gauteng and shown to be stable over time (Greyling and Tregenna, 2020; Katumba et al., 2022).

Following Bowleg's (Bowleg, 2008, 2012, 2013) recommendations on integrating an intersectional perspective in quantitative research, this study examined disparities in QoL across identities by stratifying respondents into eight distinct groups along three primary identity axes: sexual orientation, gender, and race. Gender and attraction were captured through two single-response questions: *"What is your gender?"* and *"Who are you attracted to?"* Respondents could choose "Male," "Female," "Gender Diverse," or "Prefer not to answer" as possible responses to both questions.

Respondents' answers remained confidential unless they explicitly requested fieldworker assistance for these questions (de Kadt et al., 2021). SGM/non-SGM status for each respondent was determined after recoding the gender and attraction responses. Respondents who identified as male and reported an attraction to females were categorized as "Heterosexual Men." Conversely, respondents who identified their gender as female and indicated an attraction to males were designated as "Heterosexual Women." The groups "Sexual Minority Men" and "Sexual Minority Women" included individuals who either reported same-gender or "Gender Diverse" attraction. It is important to note that the small number of individuals identifying as gender diverse precluded disaggregation beyond the gender binary, and so individuals identifying as "Gender Diverse" were excluded from our study sample–a limitation we discuss later. Respondents' sex was observed and recorded by fieldworkers, while gender identity was self-reported. Due to data limitations, we cannot definitively identify transgender respondents. For this analysis, individuals were categorized based on their self-reported gender identity (male or female), regardless of the sex recorded by fieldworkers. Similar limitations beyond South Africa's two largest racial groups (Black African and White) limited this analysis to these two race groups. Potential implications of this limitation are discussed later. The analysis sample was therefore consolidated into the following eight categories: Black Heterosexual Men, Black Sexual Minority Men, Black Heterosexual Women, Black Sexual Minority Women, White Heterosexual Men, White Sexual Minority Men, White Heterosexual Women, and White Sexual Minority Women.

Adjustment covariates included social, demographic, and economic characteristics relevant in the South African context and used in previous GCRO analyses (Akokuwebe et al., 2023; Hatcher et al., 2022). To improve comparability to these analyses, we included similar covariates: age (continuous), immigrant status (categorical), monthly household income (categorical), education (categorical), and relationship status (categorical). We also included employment status as a separate variable, considering it is not often well correlated with household income in this context. Employment status (binary) was determined from the survey question: *"In the past 7 days, did you do any type of work, business, or activity for which you got paid or expected to be paid (even if just for 1 h)? This includes selling things, piece work, and work that's part of your own business"*. Respondents who were employed, but on leave, were coded as "Yes."

2.3. Descriptive and statistical analysis

Descriptive analyses included the distribution of identity groups and covariates. The mean QoL scores for each of the eight identity groups listed above were estimated, and statistical significance of the difference between groups was assessed using Analysis of Variance (ANOVA). To ensure the generalizability of our results to the broader Gauteng population, analytic weights supplied by the GCRO (Neethling, 2021) were applied in the estimation of statistical models and descriptive statistics. Finally, to identify drivers of QoL differences, we analyzed each dimension of the QoL index and corresponding indicators across race, gender, and sexual orientation.

Studies examining the association between group membership (e.g., treatment-control, exposed-unexposed) typically use regression models with adjustment for covariates. However, the effect of group membership on the outcome may be confounded by the inclusion of these covariates in the regression models. A major source of confounding that precludes the attribution of causal relationships is selection bias, which occurs when group membership is not independent of the covariates used for adjustment (Angrist and Pischke, 2009). For example, factors leading to the selection of Black, sexual minority men into our study sample could be different in terms of income, employment status, and relationship status compared to the selection of White, heterosexual women. Furthermore, estimating the counterfactual outcome for certain groups (i.e., what their outcomes would have been had they been part of a different identity group) can be an important assessment of the potential impact of future social policy interventions. Conversely, the Average Treatment Effect (ATE) measures the average effects of group membership and their counterfactuals across the study population (Austin, 2011; Basu et al., 2023).

Well-designed randomized controlled trials (RCTs) address confounding (Angrist and Pischke, 2009; Spieth et al., 2016) and facilitate the estimation of ATEs (Twisk et al., 2018) by ensuring that the distribution of covariates between the groups is close to equal, achieving what is known as 'covariate balance' (Stanley, 2007). This balance allows attribution of variation in outcomes to the exposure itself, rather than to differences in the characteristics of the groups. In observational studies like ours, where RCTs are not feasible or ethical, we employ statistical techniques such as matching to approximate the conditions of an RCT. These techniques pair or group respondents with similar observed characteristics, aiming to balance these characteristics across comparison groups. This approach helps to satisfy the conditional independence assumption, which posits that, conditioning on the matched covariates, any remaining differences in outcomes between groups can be attributed to group membership itself rather than to matched confounders (Angrist and Pischke, 2009). Therefore, to approximate the conditions of an RCT and estimate the ATE of race, gender, and sexual attraction on QoL among respondents in the QoL survey, we utilized a robust technique that both matches respondents and calculates ATE called inverse probability weighting with regression adjustment (IPWRA) (Wooldridge, 2007). This approach offers advantages over conventional participant matching techniques because it applies weights to each observation to achieve balance, rather than discarding unmatched data (Chesnaye et al., 2022). This allows for a more accurate estimation of the ATE and

improves robustness to model misspecification (Wooldridge, 2007; Imai and Ratkovic, 2014). Finally, the use of IPWRA and the estimation of ATE can be considered a way to incorporate intersectionality in our analysis, as it allows for a more accurate comparison of outcomes between groups while accounting for potential confounding factors.

Twenty-eight separate IPWRA models were fitted to compare differences in QoL between each pair of the eight identity groups listed previously. Given the high family-wise error rate (≅78%), a Bonferroni correction was applied to maintain the overall alpha level of 5% (VanderWeele and Mathur, 2019; Weisstein). Hence, for each model, ATE estimates were only considered statistically significant if their corresponding p-value was less than 0.00178 (≅0.05/28).

2.4. Supplementary analyses

We conducted three supplementary analyses to verify the robustness of our results. First, to address potential non-linearities in the relationship between age and QoL, we included both age and age-squared as covariates. This adjustment aimed to capture non-linear effects while preserving the structure of our main analysis. Second, recognizing the potential for endogeneity in our matching variables—individuals with higher education attainment may have greater social or economic security to openly indicate an attraction to the same gender, while also benefiting from increased opportunities that improve QoL—we conducted an analysis using an IPWRA approach with matching restricted to age, an exogenous variable. This approach isolated the influence of a key confounder while excluding potentially endogenous variables (e.g., income, employment, education) from the matching step. The regression adjustment step retained the full set of covariates to address residual confounding and reduce omitted variable bias. Finally, given the number of pairwise comparisons (28 in total), we performed a post-hoc power analysis to quantify the study's ability to detect differences in QoL for each comparison.

3. Results

Our study sample consists of N = 10,760 respondents. Table 1 details their demographic and socioeconomic characteristics through unweighted frequencies and weighted percentages. Black heterosexual men and women constitute the majority of our study sample, respectively making up 39.05% (n = 3793) and 36.45% (n = 4150) of the sample each. Sexual minority respondents accounted for 12.05%. The median age was 38 (IQR: [29, 51]). Over 90% of respondents were born in South Africa–54.60% were born in Gauteng and 35.98% originated from elsewhere in South Africa. Those born outside South Africa constitute 9.42% of our study population. Regarding relationship status, our sample was nearly evenly divided among those who are single (29.80%), married (28.80%), and those in non-marital romantic partnerships (33.28%). A substantial portion (59.53%) of our study sample were not employed in the past week, higher than the official unemployment statistic for the province (approximately 38.0%) (Statistics South Africa, 2020). Income levels showed that a substantial segment (44.62%) earned less than ZAR3,201 monthly–approximately 300% of the national federal poverty level (Statistics South Africa, 2022c). Educational attainment was relatively high, with over half of the respondents (57.85%) having completed matric or higher. The overall mean QoL score was 61.10 (SD: 11.64); the mean QoL scores for each of the eight identity groups are presented in Table 2. White heterosexual men had the highest mean QoL score (72.02, SD: 8.47), while Black sexual minority women had the lowest (57.27, SD: 11.72). Without adjustment for covariates, mean QoL scores differed significantly between identity (race, sexual orientation, gender) groups ($p < 0.0001$).

Table 3 highlights group-level differences in the indicators used to compute QoL across dimensions. While not all survey questions were binary in nature, responses were categorized and presented as percentages in Table 3 for ease of comparisons across groups and dimensions. Striking gaps are evident across multiple dimensions, particularly for Black communities. In the "Services" dimension, access to piped water inside dwellings and flush toilets is nearly universal for White individuals (~97%–100%) but significantly lower for Black individuals (~63%–85%). In Socio-economic status, medical aid coverage

Table 1
Descriptive table (unmatched sample).

Sample Total	10,760	100%
Quality of Life	61.10 (11.64)	
Mean (Standard Deviation)		
Age	38; [29, 51]	
Median; [Interquartile Range]		
	Unweighted Frequency	*Weighted Percentages*
Race, Sexual Orientation, and Gender		
Black Heterosexual Men	3793	39.05%
Black Sexual Minority Men	512	5.30%
Black Heterosexual Women	4150	36.45%
Black Sexual Minority Women	674	6.11%
White Heterosexual Men	750	6.25%
White Sexual Minority Men	44	0.37%
White Heterosexual Women	799	6.21%
White Sexual Minority Women	38	0.27%
Relationship Status		
Married	3168	28.80%
Non-marital romantic partnerships	3543	33.28%
Single	3089	29.80%
Other (Divorced, Widowed, Not Specified)	960	8.11%
Education		
Did Not Complete Matriculation (Matric)	4414	41.70%
Completed Matric	3472	33.22%
Obtained Qualification Higher Than Matric	2830	24.63%
Not Stated	44	0.46%
Employment Status		
Employed	4529	40.47%
Unemployed	6231	59.53%
Region of Birth		
Gauteng	5799	54.60%
Outside Gauteng, but within South Africa	3852	35.98%
Outside South Africa	1109	9.42%
Monthly Income (Categorized)		
R1 - R800	1446	13.61%
R801 - R3,200	3227	31.01%
R3,201 - R12,800	2479	23.25%
R12,801 - R25,600	848	6.98%
R25,601 - R51,200	590	4.98%
R51,201 or more	322	2.92%
No income/Prefer not to answer/Don't Know	1848	17.25%

Table 2
Differences in quality of life by race, sexual orientation, and gender.

	Mean	Standard Deviation
Black Heterosexual Men	60.54	11.42
Black Sexual Minority Men	58.26	11.47
Black Heterosexual Women	59.09	10.89
Black Sexual Minority Women	57.27	11.72
White Heterosexual Men	72.02	8.47
White Sexual Minority Men	69.84	9.56
White Heterosexual Women	70.69	8.52
White Sexual Minority Women	70.39	7.62

ANOVA-derived p-value < 0.0001.

Table 3
Quality of life dimensions by indicator across race, gender, and sexual orientation in Gauteng, South Africa.

Dimension	Indicator	White Heterosexual Men (N = 750)	White Heterosexual Women (N = 799)	White Sexual Minority Men (N = 44)	White Sexual Minority Women (N = 38)	Black Heterosexual Men (N = 3793)	Black Heterosexual Women (N = 4150)	Black Sexual Minority Men (N = 512)	Black Sexual Minority Women (N = 674)
Services	Brick or concrete dwelling structure (% yes)[a]	99.8	99.4	100.0	100.0	82.2	82.8	78.2	79.8
	Flush toilet connected to a sewerage system (% yes)[a]	99.6	99.9	97.4	100.0	84.9	84.8	81.7	81.3
	Piped water inside dwelling (% yes)[a]	97.0	96.6	88.6	100.0	69.3	69.6	64.5	62.9
	Formal electricity supply (% yes)[a]	97.7	96.1	91.7	89.4	86.2	86.0	82.0	84.9
	Regular refuse removal from home (% yes)[a]	89.6	90.2	90.0	89.6	81.2	81.0	79.1	78.2
	Household owns working television (% yes)[a]	93.3	93.3	96.4	97.9	85.1	88.7	82.3	87.5
Socio-economic status	Personally covered by medical aid (% yes)[a]	74.7	73.9	66.7	52.7	15.9	13.3	9.4	7.9
	Highest level of education completed (% matric or higher)[a]	86.7	84.7	78.1	86.9	56.8	52.6	45.9	47.0
	Household has working internet connection (% yes)[a]	77.7	76.0	85.3	66.8	17.6	13.1	9.6	9.8
	Employment status (% employed)[a]	63.2	48.6	50.5	35.0	47.2	29.9	41.5	27.4
	Monthly household income (% greater than ZAR3,200)[a]	60.2	60.1	78.1	46.3	37.4	34.6	30.0	22.8
Government satisfaction	Satisfaction with national government (% satisfied or very satisfied)	19.7	19.7	25.5	21.6	33.2	34.4	37.4	33.4
	Satisfaction with provincial government (% satisfied or very satisfied)	17.3	20.8	18.5	33.4	31.0	29.7	33.8	29.6
	Satisfaction with local municipality (% satisfied or very satisfied)	33.6	33.8	38.8	25.9	25.8	23.0	24.1	23.1
	Government has improved quality of life (% yes)[a]	46.6	49.6	55.0	55.1	58.4	57.7	57.8	54.8
	Agree most government adhere to Batho Pele (people first) principles (% agree or strongly agree)	16.4	16.1	12.2	29.8	17.0	17.6	17.1	15.7
Life satisfaction	Satisfaction with family (% satisfied or very satisfied)	82.0	77.9	86.4	85.1	69.7	78.3	68.6	77.9
	Satisfaction with time to do things you want (% satisfied or very satisfied)	72.6	72.3	72.1	76.8	60.5	63.7	61.8	63.3
	Satisfaction with leisure time (% satisfied or very satisfied)	84.3	81.0	76.8	88.2	66.0	65.0	61.1	66.5
	Satisfaction with friends (% satisfied or very satisfied)	89.8	87.6	88.8	86.5	71.9	62.6	70.7	65.3
	Satisfaction with standard of living (%	88.5	86.9	91.0	88.6	52.0	52.6	44.8	49.7

(*continued on next page*)

Table 3 (*continued*)

Dimension	Indicator	White Heterosexual Men (N = 750)	White Heterosexual Women (N = 799)	White Sexual Minority Men (N = 44)	White Sexual Minority Women (N = 38)	Black Heterosexual Men (N = 3793)	Black Heterosexual Women (N = 4150)	Black Sexual Minority Men (N = 512)	Black Sexual Minority Women (N = 674)
	satisfied or very satisfied)								
Health	Health status enables daily work (% always or almost always)	85.9	82.5	87.8	73.0	82.4	73.7	83.4	72.2
	Health status enables usual social activities (% always or almost always)	87.4	84.2	87.6	74.6	83.1	74.7	83.7	76.5
	Health status in the past four weeks (% good or excellent)	93.1	92.0	95.4	87.9	91.0	85.5	89.6	84.7
Safety	Feels safe walking in their neighborhood during the day (% safe or very safe)	83.6	76.2	85.6	70.0	82.8	73.5	81.7	68.3
	Feels safe walking in their neighborhood after dark (% safe or very safe)	19.2	12.5	31.6	1.7	21.1	13.9	23.5	15.5
	Feels safe at home (% safe or very safe)	94.9	93.5	94.7	93.3	87.2	82.8	89.3	79.4
	Believes the crime situation in their neighborhood is improving (% improved)	17.5	15.0	20.0	25.9	25.0	20.4	22.5	18.9
	Believes that most people in their community can be trusted (% yes)[a]	66.8	61.5	48.1	62.8	35.5	31.9	31.9	30.4
Participation	Participated in organized social activities in the last year (% yes)[a]	64.3	58.8	47.9	74.2	68.6	77.4	69.0	78.3
	Participated in formal political engagements in the last year (% yes)[a]	31.7	27.3	19.3	28.0	53.3	58.3	54.4	62.3
	Would like to receive municipal communication (% yes)[a]	98.1	98.5	97.0	100.0	98.8	99.1	98.5	99.7
	Voted in the 2019 National elections (% voted)	82.22	76.85	80.35	69.91	58.75	64.24	54.49	63.01

[a] Indicates the proportion of respondents who selected a specific response option that was classified as "yes" for the purposes of this specific analysis.

ranges from ~53% to 75% for White individuals, compared to just ~8%–16% for Black individuals. Similarly, fewer than 20% of Black individuals have working internet connections, compared to over 75% of White individuals. In Life satisfaction, fewer than 53% of Black individuals are satisfied with their standard of living, compared to over 85% of White individuals, with Black sexual minorities reporting the lowest satisfaction levels (~45%–50%). The Safety dimension shows consistently low perceptions of safety after dark, with Black sexual minority women feeling the least safe (~15%). Additionally, trust in the community is far higher among White individuals (~49%–67%) than Black individuals (~30%–35%). In Participation, Black individuals report higher rates of social and political engagement (~53%–78%) than White individuals (~19%–64%), demonstrating active involvement despite systemic inequities.

Disparities by sexual minority status are also evident within racial groups in Table 3. Sexual minorities generally report lower medical aid coverage and employment rates. For instance, Black sexual minority women have the lowest medical aid coverage (~8%) and employment rates (~27%) among Black individuals. Similarly, White sexual minority men (~67%) and women (~53%) have lower medical aid coverage compared to White heterosexual men (~75%). In Life satisfaction, sexual minorities report lower satisfaction with their standard of living, with Black sexual minority women (~45%) trailing behind Black heterosexual women (~53%). In Safety, sexual minorities consistently feel less safe than their heterosexual peers; White sexual minority women (~2%) feel far less safe walking after dark than White heterosexual men (~19%). Finally, in Participation, sexual minorities, such as White sexual minority men (~19%), are less politically engaged than their heterosexual counterparts (~32%). These findings highlight systemic disadvantages faced by sexual minorities, particularly Black sexual minorities, across various dimensions of the QoL index.

Table 4 presents the results from the 28 IPWRA models. Each model compares the QoL index score between two groups defined by their gender, SGM status, and race, resulting in a comprehensive pairwise comparison across eight distinct categories: White Heterosexual Men, White Heterosexual Women, White Sexual Minority Men, White Sexual Minority Women, Black Heterosexual Men, Black Heterosexual Women, Black Sexual Minority Men, and Black Sexual Minority Women. The

Table 4
Estimated average treatment effects (ATE) differences in quality of life across intersecting identities: Gender, sexual minority status, and race.

	… White Heterosexual Men	… White Heterosexual Women	… White Sexual Minority Men	… White Sexual Minority Women	… Black Heterosexual Men	… Black Heterosexual Women	… Black Sexual Minority Men	… Black Sexual Minority Women
White Heterosexual Men vs …	0.00	−0.51 (−1.42,0.40)	−2.25 (−6.44,1.94)	−1.20 (−3.22,0.82)	−5.51*** (−7.02, −3.99)	−6.05*** (−7.50,-4.60)	−4.90*** (−6.78,-3.01)	−5.67*** (−7.24,-4.10)
White Heterosexual Women vs …	–	0.00	−2.86 (−7.10,1.39)	−1.16 (−2.86,0.54)	−3.37** (−5.40,-1.34)	−4.83*** (−6.98,-2.69)	−3.79*** (−5.83, −1.74)	−4.60*** (−6.65,-2.55)
White Sexual Minority Men vs …	–	–	0.00	1.81 (−2.98,6.61)	−2.87 (−6.82,1.07)	−1.69 (−5.30,1.92)	−6.46* (−12.55,-0.38)	−3.52 (−11.23,4.19)
White Sexual Minority Women vs …	–	–	–	0.00	−12.05*** (−14.09,-10.02)	−12.31*** (−15.61,-9.03)	−14.47*** (−17.18,-11.76)	−14.23*** (−16.59,-11.87)
Black Heterosexual Men vs …	–	–	–	–	0.00	−0.98** (−1.54,-0.42)	−0.41 (−1.62,0.79)	−1.25* (−2.36,-0.13)
Black Heterosexual Women vs …	–	–	–	–	–	0.00	0.34 (−0.85,1.52)	−0.24 (−1.27,0.79)
Black Sexual Minority Men vs …	–	–	–	–	–	–	0.00	0.82 (−0.73,2.37)
Black Sexual Minority Women vs …	–	–	–	–	–	–	–	0.00

*p-value <0.05; ** p-value <0.001; *** p-value <0.0001.

table is structured with both rows and columns representing these categories. Each cell provides the estimated difference in QoL between the group listed in the column (treated as the exposure group) and the group listed in the row (treated as the comparison group) together with their 95% confidence intervals.

Estimates for ATEs found that significant QoL disparities were observed, independent of observed characteristics (e.g., income, education). No significant differences were observed when comparing sexual orientation or gender within White populations. However, when compared to White heterosexual men, notable differences in QoL scores were found among Black heterosexual men (ATE: -5.51; 95%CI: -7.02, −3.99), Black heterosexual women (ATE: -6.05; 95%CI: -7.50,-4.60), Black sexual minority men (ATE: -4.90; 95%CI: -6.78,-3.01), and Black sexual minority women (ATE: -5.67; 95%CI: -7.24,-4.10). Similarly, when compared to White heterosexual women, disparities persisted with Black heterosexual men (ATE: -3.37; 95%CI: -5.40,-1.34), Black heterosexual women (ATE: -4.83; 95%CI: -6.98, −2.69), Black sexual minority men (ATE: -3.79; 95%CI: -5.83,-1.74), and Black sexual minority women (ATE: -4.60; 95%CI: -6.65, −2.55). ATE estimates comparing White sexual minority men with both Black heterosexuals and sexual minorities were not considered statistically significant at the Bonferroni-corrected threshold of 0.00178. Compared to White sexual minority women, all Black groups exhibited significantly lower scores: Black heterosexual men (ATE: -12.05; 95%CI: -14.09,-10.02), Black heterosexual women (ATE: -12.31; 95%CI: -15.61,-9.03), Black sexual minority men (ATE: -14.47; 95%CI: -17.18,-11.76), and Black sexual minority women (ATE: -14.23; 95%CI: -16.59,-11.87). As for comparisons within Black population groups, only the difference between heterosexual men and women reached statistical significance, but was modest, with Black heterosexual women having significantly lower scores compared to Black heterosexual men (ATE: -0.98,95%CI: -1.54,-0.42).

3.1. Results of supplementary analyses

The results of our supplementary analyses are presented in the appendix. In the analysis that included matching on both age and age-squared (Supplementary Table 1), most differences observed in our original analyses were confirmed, albeit with some variations in point estimates and wider confidence intervals. However, in contrast with our main results, differences between White heterosexual women and Black men (both heterosexual and sexual minority) did not reach statistical significance. Including both age and age-squared introduced high multicollinearity in the models (VIF = 28.97), which likely biased the results. Consequently, we retained these findings as secondary analyses. The results of the analysis that matched only on age (Supplementary Table 2) closely aligned with those of the primary analysis, with similar point estimates and confidence intervals, though some variations in magnitude and interval length were noted.

The post-hoc power analysis (Supplementary Table 3) indicates sufficient power to detect differences in QoL between Black and White groups (power, 1-β = 1.00 for all comparisons) at the Bonferroni-adjusted p-value. We also had adequate power to detect differences between Black sexual minority women and Black heterosexual men (1-β = 0.96) and between Black heterosexual men and women (1-β = 0.80). However, we were underpowered to detect differences among other Black groups and within White groups (median 1-β = 0.07; range = [0.00, 0.41]). Although observed differences in QoL are present in these groups (Tables 2 and 3), the lack of sufficient power likely limited our ability to detect statistical significance.

4. Discussion

In the 30 years since the advent of democracy, South Africa has made significant economic and social gains for many of its non-White citizens (Majozi, 2017). However, the continuation of White dominance in business and land ownership (Rural Development and Land Reform, 2017), one-party rule until 2024, a deeply embedded history of corruption (Friedman, 2020), the scourge of gender-based violence (Department of Women et al., 2020), and the economic and social impact of the HIV/AIDS epidemic (Satoh and Boyer, 2019) has hindered the closure of societal fissures in first three decades of democracy. We find that, despite the gains made during this time, there are still deep inequities at the intersections of three important identities-ones that are not muted by increased access to education or economic advantage, but rather deeply embedded in the social construct of race and race

relations.

Overall, we find that, on average, White, heterosexual men in Gauteng score more than 5 points higher on the GCRO QoL index than Black, heterosexual men and 6 points higher than Black, heterosexual women. Among women, white, heterosexual women score more than 12 points higher than Black, heterosexual men and women. These results mirror those of Møller and colleagues in their survey of South Africans in the decade after Apartheid (Møller, 2007). In their South African Quality of Life Trends Study, initial gains in QoL among Black respondents after the fall of Apartheid were wiped out by the end of the first decade of democracy. In a similar study using data from 2014 (the second decade of democracy), Møller and colleagues found that rates of life satisfaction and overall happiness among Black South Africans were still significantly lower than all other race groups–especially Whites (Møller and Roberts, 2017). Together with the results of our study, this paints a picture of stubbornly persistent inequality in QoL by race, suggesting that current policies aimed at improving equity between Black and White South Africans are not paying dividends when measured using a holistic measure of life satisfaction such as QoL.

In addition to updating the literature on QoL differences between South Africa's two largest (and most disparate) race groups, we build on Møller's work by including additional axes of identity (i.e., gender, sexual orientation). Before adjusting for covariates, we find that Black respondents in all groups have average QoL scores that are more than 12 points lower than White heterosexual men, while Black sexual minority men and women have an overall QoL measure that is more than 11 points below that of their White sexual minority counterparts. The largest differences in QoL are between White, heterosexual men and Black, sexual minority women–a gap of more than 15 points. This is consistent with intersectionality theory, which proposes that additional axes of marginalization (race, gender, and sexual orientation) are likely to compound the structural stress felt by members of any one of these groups (Crenshaw, 1991; Bowleg, 2008; Lett et al., 2022).

When adjusting for important covariates using the rigor of an IPWRA and ATE approach, we find that significant differences in QoL persist across axes of race, gender, and sexual orientation–though only among Black South Africans. Among Black South Africans, heterosexual men had significantly higher QoL than sexual minority men, heterosexual women, and sexual minority women. This is controlling for the impact of education, wealth, and other important social indicators that are commonly touted as drivers of QoL (Everatt, 2017). Among White South Africans, differences in QoL between heterosexual men, heterosexual women, sexual minority men, and sexual minority men do not approach statistical significance. This is not to say that gender inequality and homonegative stigma do not exist among White South Africans. However, it may be that not contending with structural racism–the cumulative nature of historical and societal marginalization (Lett et al., 2022) –affords greater access to the protections afforded by South Africa's progressive constitution (Constitution of the Republic of, 1997). Secondly, according to Møller, access to healthcare and a better quality-built environment are key determinants of QoL in South Africa, regardless of gender or sexual orientation. Given Gauteng is still heavily segregated by race (Hamann, 2024), White South Africans of all income and education levels tend to live in more affluent suburbs with better service delivery and infrastructure than a majority of Black South Africans (Møller, 2007). This means that, in this context, a respondent's race is likely a structural advantage above and beyond its ability to afford access to upward social mobility and therefore improved QoL.

It follows that the differences in QoL within race are minute compared to those with multiple marginalized identities between races. In adjusted analyses, the largest gap in QoL was between White sexual minority women and Black sexual minority women–a difference of more than 12 points. This finding aligns with the complex reality faced by Black sexual minority women in South Africa. While both Black and White sexual minority women contend with structural inequities related to gender inequality and homonegative bias, Black sexual minority women face unique challenges, including increased risk of sexual violence (e.g., corrective rape) compared to their White counterparts (Fletcher, 2014; Gaitho, 2022; Mwambene and Wheal, 2015). Just as in Crenshaw's initial example of Black women in the United States, sexual minority, Black women in South Africa often fall through the cracks of legal and policy interventions, which tend to focus more on the needs of cisgender, heterosexual women, and cisgender, sexual minority men. The intersectionality of race, gender, and sexual orientation creates a distinct set of vulnerabilities for Black, sexual minority women that may not be fully captured by examining gender or sexual minority status alone (Bowleg, 2008). Furthermore, in urban, diverse, progressive, and relatively affluent Gauteng, social norms regarding gender and sexual orientation may be less salient than race. Stated conversely, the 'protection' that whiteness affords in this context could potentially outweigh the marginalization experienced due to one's gender and sexual orientation.

While these findings are robust, our post-hoc power analysis revealed limitations in detecting differences within certain groups, particularly among White individuals and smaller Black subgroups, such as sexual minorities. We had sufficient power to detect differences in QoL between Black and White groups, as well as significant differences within Black South Africans, particularly between heterosexual men and other identity groups. However, our analysis was underpowered for many comparisons within White groups and some Black subgroups, limiting our ability to statistically confirm smaller differences. These results point to an important opportunity for future iterations of the GCRO survey: oversampling underrepresented groups, such as sexual minorities and gender-diverse individuals, would enable more precise estimates of QoL differences and provide stronger statistical power to examine intersectional disparities. This would not only enhance the survey's utility for intersectional research but also better inform targeted policy interventions.

Our adjusted results support the notion that race in population health studies is merely a proxy for exposure to systemic racism (Lett et al., 2022). This is not to say that the many inequalities in educational attainment, employment, income, and other factors do not influence QoL. Indeed, the secondary school completion rate among White South Africans stands at 71.6%, while Black students' completion rate is significantly lower (53.5%) (Broekhuizen et al., 2016). Unemployment among Black South Africans overall is nearly three times higher than for White South Africans (36.3% vs 9.2%) (Maluleke, 2024). However, the adjusted results support the perspective that these are instead mediators of the relationship between race/racism and QoL (Lett et al., 2022). That is, race is not merely a proxy for these inequalities, but rather, it is racism itself that continues to *drive them.* This is a departure from the majority of the QoL literature in South Africa, which purports that things such as education, income, and access to goods and services are key to improving QoL (Everatt, 2017). Instead, our results account for much of these variations and show that race is still a deciding factor for an individual's QoL in Gauteng.

Together, the results of these analyses suggest that social policies to improve educational attainment, employment, and economic well-being are unlikely (on their own) to alleviate disparities in QoL between Black and White South Africans or between sub-categories of female and sexual minority South Africans. Interrogating the significant differences in QoL within dimensions, it may be prudent to enact policies that specifically focus on infrastructure development in poor urban areas-such as adding internet and sanitation services to "informal" settlements and low-income areas of the province. Similarly, outreach to specific communities at the intersection of multiple marginalized identities-such as Black, sexual minority women, to understand which policies and interventions would best improve their sense of safety, are key next steps. Considering the intersectional perspective that all systems of oppression (racism, gender inequality, and homonegative bias) are interactive and mutually reinforcing, changing the fundamental nature of these biases–in the hearts and minds of all South Africans–is

necessary for lasting, systemic change of the sort that leads to diminished QoL disparities between these groups. Enacting such systemic change is monumental. Doing so requires interventions at the behavioral, structural, and policy levels simultaneously and along all three axes of marginalization studied in this analysis. The good news is that South Africa has a history and present of understanding the limitations of its current policies and creating action plans to rectify them. In 2021, the South African government approved the National Action Plan to Combat Racism, Racial Discrimination, Xenophobia, and Related Intolerance, a comprehensive document outlining a whole-of-government approach to reducing these deeply-rooted issues (Department of Justice and Constitutional Development, 2019). To operationalize the goals of the Plan, academics, civic society, and non-governmental actors are called upon to create and scale effective behavioral, structural, and policy interventions aimed at reducing racism, gender inequality, and homonegative bias. Additionally, adopting an intersectional approach in all aspects of the plan's implementation will ensure that the goals of the Plan are designed to address the interconnected nature of different forms of oppression. Taking a decidedly intersectional perspective that understands the mutually reinforcing nature of systems of oppression, the Plan advocates for an end to gender-based violence and homonegative hate crimes as a means to improve social cohesion and reduce racial bias.

The bad news is that South Africa often struggles with the implementation of its ambitious National Action Plans. A similar National Action Plan to end Gender-based Violence and Femicide had similarly ambitious goals, but a lack of adequate funding and national prioritization has rendered it largely unenacted (Department of Women et al., 2020). However, a recent positive step was taken on May 24, 2024, when President Cyril Ramaphosa signed the Gender-Based Violence and Femicide (GBVF) Bill (Minister of Women et al., 2022; SAnews.gov.za, 2024), which aims to strengthen the legal framework and funds national efforts to eradicate violence against women and children. This new law is a significant step that has the potential to help alleviate corrective rape incidents against Black sexual minority women in resource-poor townships, potentially contributing to improved QoL.

Such steps are largely the result of significant and sustained pressure from feminist movements (Weldon and Htun, 2013). Lessons can be drawn from the decades of leadership of feminist organizers to expand their tactics to include combatting racism and homonegative bias. It is then incumbent upon the South African government and the new Government of National Unity (Government Communication and Information System, 2024) to prioritize the funding necessary to fully implement and measure the success of the National Action Plan to Combat Racism, Racial Discrimination, Xenophobia, and Related Intolerance, using it as a roadmap to greater prosperity and improved QoL for all South Africans.

For its part, the GCRO can aid in the measurement of the success of the National Action Plan by allowing the selection of multiple sexual and gender identities in its survey instrument. It could also oversample gender-diverse and racial minority (especially Indian/Asian and Coloured) groups to ensure adequate sub-samples of sexual minority and gender minority respondents. Finally, future iterations of the GCRO QoL measure should consistently measure these constructs to allow for longitudinal analyses of the sort Møller and colleagues completed in the first two decades of democracy.

A key limitation of this work is the binary choices with which respondents were presented regarding their gender and attraction. That is, respondents could only select one gender and one gender attraction on the GCRO survey. Additionally, while sex was observed and recorded by fieldworkers, gender identity was self-reported, which may result in misclassification of some individuals, particularly those with gender diverse identities. This means that individuals with multiple identities and/or attractions may be miscoded in our study. It also adds to the bisexual erasure that is too common in studies of sexual and gender minority communities, overlooking the distinct needs and experiences of individuals with multi-gender attractions (Feinstein and Dyar, 2017; Sarno et al., 2020). Future iterations of the QoL survey are set to include more expansive measures of sexual orientation and gender identity, which will allow for more detailed analyses in the future.

The sample composition also presented challenges. Although South Africa officially recognizes four primary population groups (Statistics South Africa, 2022a) Black African (81.4%), White (7.3%), Indian/Asian (2.7%), and Coloured (8.2%), the numbers of sexual minority respondents among minority race groups were low, particularly among White ($n = 82$), Coloured ($n = 31$), and Indian/Asian ($n = 4$) populations. The especially low number of Coloured and Indian/Asian respondents necessitated their removal from our analysis, limiting our ability to capture the experiences of these groups comprehensively. Similarly, due to the low numbers of gender-diverse respondents, gender was treated as a binary variable. This limitation is particularly significant given that research has shown that gender-diverse individuals in Gauteng face unique challenges and have markedly different experiences compared to their cisgender counterparts (Muller, 2014; Naidoo et al., 2024), which obscures the specific QoL differences experienced by these individuals. Related to this point, the sampling frame did not allow us to weight by SGM status and proxies such as urbanicity and religiosity were not considered. This, in addition to the relatively small (but proportional) number of White respondents being subsumed into larger, municipal sampling units may have artificially depressed the prevalence of SGM respondents in this sub-group. Our future work aims to improve upon the sampling strategy and weighting techniques to ensure racial minorities are adequately and accurately represented. Finally, the data for QoL 6 was collected during the height of the COVID-19 pandemic. While the pandemic did not significantly impact the data collection process, QoL was likely significantly impacted across South African society, and to different degrees based on some of the axes of marginalization we discuss here. Therefore, the disparities in QoL may be, in part, an artifact of the time in which data were collected. Repeated analyses with future QoL surveys will help illuminate the impact of the pandemic on QoL in Gauteng.

Overall, the sample is representative of Gauteng province–South Africa's most densely populated and economically vibrant area. Anchored by urban Johannesburg, Gauteng often outperforms other provinces, due to its more developed social services and education system relative to other areas. This means that the results of this study are not likely generalizable to the whole of South Africa. Of note, Gauteng commonly attracts migrants from all areas of South Africa and is a common destination for migrants from other Southern African nations. Approximately one-third (35%) of residents were born outside the province, with foreign-born residents comprising approximately 14% (Centre for Development and Enterprise, 2008), numbers with which our sample aligns. While the QoL survey does ask about immigrant status, our analysis kept this as a covariate, but did not include this as an additional axis of identity due to sample size limitations. Given rising tensions regarding migrants (especially those who are foreign-born) in the province and the potential for these tensions to negatively impact QoL (Centre for Development and Enterprise, 2008), future iterations of the QoL survey may consider oversampling migrants who are also sexual and gender minorities to allow for more nuanced intersectional analyses.

One major strength is the consideration of each axis of identity (race, gender, and sexual orientation) in the context of the other, which acknowledges the mutually constitutive nature of these identities. This approach contrasts with the common approach in the literature, which often includes these variables in an additive manner, such as modeling the relationship between the outcome and the predictors using a specification akin to "outcome ~ race + gender + orientation". On the other hand, due to limitations with the survey construction, the treatment of gender as a binary variable due to the negligible number of White respondents identifying as "Gender Diverse" means that the experiences of such individuals are not captured in our study. Similarly, the

experiences of those who identified with a gender different than the fieldworker-observed sex were subsumed into binary, cisgender categories-erasing the unique vulnerabilities faced by these individuals. However, the use of IPWRA and ATE estimation in our study represents a methodological strength compared to traditional additive models, as it allows for a more nuanced understanding of the intersectional experiences of individuals by addressing confounding and selection bias. It is crucial to acknowledge that even these advanced statistical methods may not fully capture the complexities of intersectionality as described by Bowleg (2008), emphasizing the need to interpret the findings within the broader socio-historical context of systemic oppression and privilege in South Africa. Finally, although IPWRA is robust in addressing confounding, it cannot fully account for all potential confounding pathways linking group identity to differences in QoL. The validity of causal interpretations relies on the assumption that no unobserved variables are correlated with both the outcome (QoL) and the probability of group membership (Basu et al., 2023)—a condition that cannot be definitively met with the available data. Additionally, variables such as employment and income, may act as mediators rather than confounders, potentially introducing post-treatment bias. Therefore, the relationships observed in this study should be interpreted as associative rather than causal. However, the consistency of our findings across both the main and supplementary analyses lends confidence to the robustness of these associations.

It is also important to consider the potential for positive selection bias in the sample, particularly among sexual and racial minority groups. Given their geographic and demographic characteristics, individuals in the sample may represent those at the higher end of the distribution for certain socioeconomic or health outcomes within their respective groups. This selection bias could result in an underestimation of the true magnitude of disparities. Furthermore, self-reported sexual minority status may introduce additional biases, as individuals comfortable disclosing their identities may differ systematically from those who are not. While these biases represent inherent limitations of survey-based studies, they do not detract from the significance of the observed disparities, which consistently highlight inequities across multiple dimensions of QoL.

5. Conclusions

South Africa's young democracy has made significant progress in dismantling the legacy of Apartheid, but challenges remain. While wide disparities in QoL exist for Black, female, and sexual minority residents of Gauteng, daily confrontations with structural racism seem to be the largest arbiter of respondents' overall QoL and well-being. While social policies designed to improve educational attainment, employment, and other individual facets of QoL may be popular with some groups, they do not address the fundamental causes of these disparities. Rather, it is the centuries-old legacy of racial segregation that continues to shape South African society more than 30 years into majority rule. Without addressing individual mindsets and structural inequities through dedicated implementation of the National Action Plan to Combat Racism, Racial Discrimination, Xenophobia, and Related Intolerance, the threat of yet another decade of unrealized potential for the Rainbow Nation remains.

CRediT authorship contribution statement

Nicholas Metheny: Writing – review & editing, Writing – original draft, Supervision, Project administration, Methodology, Funding acquisition, Formal analysis, Conceptualization. **Gabriel John Dusing:** Writing – review & editing, Writing – original draft, Software, Methodology, Investigation, Formal analysis, Data curation. **Pedzisai Ndagurwa:** Validation, Supervision, Methodology. **Sthembiso Pollen Mkhize:** Writing – review & editing, Writing – original draft, Formal analysis, Validation, Visualization.

Ethical approval

Ethical approval for this study was secured from the Human Research Ethics Committee of the University of the Witwatersrand, Johannesburg.

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Declaration of conflicting interests

The author(s) declared a potential conflict of interest (e.g., a financial relationship with the commercial organizations or products discussed in this article) as follows: Dr. Metheny received compensation as a consultant from the Gauteng City Region Observatory.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.socscimed.2024.117651.

Data availability

Data is available for use under a Creative Commons Attribution 4.0 International License at https://www.datafirst.uct.ac.za/dataportal/index.php/collections/GCRO.

References

Akokuwebe, M.E., Likoko, S., Osuafor, G.N., Idemudia, E.S., 2023. Determinants of life satisfaction among migrants in South Africa: an analysis of the GCRO's quality of life survey (2009–2021). BMC Publ. Health 23 (1), 2030.

Angrist, J.D., Pischke, J.S., 2009. Mostly Harmless Econometrics: an Empiricist's Companion. Princeton University Press, Princeton, New Jersey Oxford, p. 373.

Austin, P.C., 2011. An introduction to propensity score methods for reducing the effects of confounding in observational studies. Multivariate Behav. Res. 46 (3), 399–424.

Basu, A., Unuigbe, A., Masseria, C., 2023. Understanding differences between what alternate propensity score methods estimate. J Manag Care Spec Pharm 29 (4). https://doi.org/10.18553/jmcp.2023.29.4.391.

Bleys, B., 2012. Beyond GDP: classifying alternative measures for progress. Soc. Indicat. Res. 109 (3), 355–376.

Bowleg, L., 2008. When black + lesbian + woman ≠ black lesbian woman: the methodological challenges of qualitative and quantitative intersectionality research. Sex. Roles 59 (5), 312–325.

Bowleg, L., 2012. The problem with the phrase women and minorities: intersectionality—an important theoretical framework for public health. Am. J. Publ. Health 102 (7), 1267–1273.

Bowleg, L., 2013. "Once you've blended the cake, you can't take the parts back to the main ingredients": black gay and bisexual men's descriptions and experiences of intersectionality. Sex. Roles 68 (11), 754–767.

Broekhuizen, H van, van der, Berg S., Hofmeyr, H., 2016. Higher Education Access and Outcomes for the 2008 National Matric Cohort [Internet]. University of Stellenbosch [cited 2024 Jul 23]. (Stellenbosch Working Paper Series). Report No.: WP16/2016. Available from: https://www.ekon.sun.ac.za/wpapers/2016/wp162016.

Centre for Development and Enterprise, 2008. Immigrants in Johannesburg: estimating numbers and assessing impacts. Johannesburg, South Africa: Centre for Development and Enterprise (Bernstein A, editor. CDE In Depth). Report No.: 9.

Chesnaye, N.C., Stel, V.S., Tripepi, G., Dekker, F.W., Fu, E.L., Zoccali, C., et al., 2022. An introduction to inverse probability of treatment weighting in observational research. Clin Kidney J 15 (1), 14–20.

Constitution of the Republic of South Africa [No. 108 of 1996], 1997. Sect. 7-39 Feb 4.

Crenshaw, K., 1989. Demarginalizing the intersection of race and sex: a black feminist critique of antidiscrimination doctrine. Feminist Theory and Antiracist Politics 1989 (1). Article 8. Available from: http://chicagounbound.uchicago.edu/uclf.

Crenshaw, K., 1991. Mapping the margins: intersectionality, identity politics, and violence against women of color. Stanford Law Rev. 43 (6), 1241–1299.

Department of Justice and Constitutional Development, 2019. National Action Plan to Combat Racism, Racial Discrimination, Xenophobia and Related Intolerance [Internet]. Available from. https://www.justice.gov.za/nap/index.html.

Department of Women, Youth, and Persons with Disabilities, 2020. National strategic plan on gender-based violence & femicide: human dignity and healing, safety.

FREEDOM & EQUALITY IN OUR LIFETIME [Internet] [cited 2024 Jul 23]. Available from: https://www.samrc.ac.za/sites/default/files/attachments/2022-09/NSPGenderBasedVF.pdf.
Van Der Berg, S., 2007. Apartheid's enduring legacy: inequalities in education. J. Afr. Econ. 16 (5), 849–880.
Ebrahim, A., Botha, F., Snowball, J., 2013. Determinants of life satisfaction among race groups in South Africa. Dev. South Afr. 30 (2), 168–185.
Everatt, D., 2017. Quality of life in the Gauteng city-region, South Africa. Soc. Indicat. Res. 130 (1), 71–86.
Feinstein, B.A., Dyar, C., 2017. Bisexuality, minority stress, and health. Curr. Sex Health Rep. 9 (1), 42–49.
Fletcher, C., 2014. Corrective rape in South Africa: cultural issues and policy solutions. LGBTQ Policy J 5.
Friedman, S., 2020. How corruption in South Africa is deeply rooted in the country's past and why that matters. The Conversation [Internet] [cited 2024 Jul 23]; Available from: http://theconversation.com/how-corruption-in-south-africa-is-deeply-rooted-in-the-countrys-past-and-why-that-matters-144973.
Gaitho, W., 2022. Curing corrective rape: socio-legal perspectives on sexual violence against black lesbians in South Africa. William Mary J Race Gend Soc Justice 28, 329.
Government Communication and Information System, 2024. Government of national unity: a moment of profound significance | SAnews. SANews [internet] [cited 2024 Jul 23]; Available from: https://www.sanews.gov.za/south-africa/government-national-unity-moment-profound-significance.
Greyling, T., 2013. A composite index of quality of life for the Gauteng city-region: a principal component analysis approach [Internet] Gauteng City-Region Observatory [cited 2024 Mar 12]. (Occasional Paper). Available from: https://www.gcro.ac.za/outputs/occasional-papers/detail/a-composite-index-of-quality-of-life-for-the-gauteng-city-region-a-principal-component-analysis-approach/.
Greyling, T., Tregenna, F., 2020. Quality of life: validation of an instrument and analysis of relationships between domains. Dev. South Afr. 37 (1), 19–39.
Groenmeyer, S., 2011. Intersectionality in apartheid and post-apartheid South Africa: unpacking the narratives of two working women. Gend. Technol. Dev. 15 (2), 249–274.
Hamann, C., 2024. An analysis of microscale segregation and socio-economic sorting in Gauteng [Internet]. Gauteng City-Region Observatory [cited 2024 Jul 23]. (Occasional Paper). Available from: https://www.gcro.ac.za/outputs/occasional-papers/detail/an-analysis-of-microscale-segregation-and-socio-economic-sorting-in-gauteng/.
Hamann, C., de Kadt, J., 2021. GCRO Quality of Life Survey 6 (2020/21): Sample Design. Gauteng City-Region Observatory (GCRO), Johannesburg.
Hanf, T., Weiland, H., Vierdag, G., 1981. South Africa, the Prospects of Peaceful Change: an Empirical Enquiry into the Possibility of Democratic Conflict Regulation.
Hatcher, A.M., Mkhize, S.P., Parker, A., De Kadt, J., 2022. Depressive symptoms and violence exposure in a population-based sample of adult women in South Africa. In: Waqas, A. (Ed.), PLOS Glob Public Health 2 (11), e0001079.
van Heerden, G., 2023. An In-Depth Look into the Quality of Life of LGBT South Africans [Internet]. South African Institute of Race Relations [cited 2024 Aug 12]. Available from: https://irr.org.za/reports/occasional-reports/files/an-in-depth-look-into-the-quality-of-life-of-lgbt-south-africans.pdf.
Henrard, K., 2002. Post apartheid South Africa's democratic transformation process: redress of the past, reconciliation and 'unity in diversity. Glob. Rev. Ethnopolit. 1 (3), 18–38.
Hsieh, N., Ruther, M., 2016. Sexual minority health and health risk factors. Am. J. Prev. Med. 50 (6), 746–755.
Imai, K., Ratkovic, M., 2014. Covariate balancing propensity score. J R Stat Soc Ser B Stat Methodol 76 (1), 243–263.
de Kadt, J., Hamann, C., Mkhize, S.P., Parker, A., 2021. Quality of Life Survey 6 (2020/21): Overview Report [Internet]. Gauteng City-Region Observatory [cited 2024 Apr 18]. Available from: https://www.gcro.ac.za/outputs/data-briefs/detail/quality-life-survey-6-202021-overview-report/.
Katumba, S., De Kadt, J., Orkin, M., Fatti, P., 2022. Construction of a reflective quality of life index for Gauteng province in South Africa. Soc. Indicat. Res. 164 (1), 373–408.
Khuluvhe, M., 2021. Adult Illiteracy in South Africa [Internet]. Department of Higher Education and Training, Pretoria, South Africa [cited 2024 Aug 1]. Available from: https://lmi-research.org.za/wp-content/uploads/2021/06/Fact-Sheet-on-Adult-Illiteracy-in-South-Africa-March-2021.pdf.
Kohut, A., 2013. The global divide on homosexuality: greater acceptance in more secular and affluent countries. Wash DC Pew Res Cent.
Koomson, I., Awaworyi, Churchill S., 2022. Employment precarity and energy poverty in post-apartheid South Africa: exploring the racial and ethnic dimensions. Energy Econ. 110, 106026.
Lett, E., Asabor, E., Beltrán, S., Cannon, A.M., Arah, O.A., 2022. Conceptualizing, contextualizing, and operationalizing race in quantitative health sciences research. Ann. Fam. Med. 20 (2), 157–163.
Majozi, P., 2017. Have Black Peoples' Lives Improved after Apartheid? Polity [Internet] [cited 2024 Aug 5]; Available from: https://www.polity.org.za/article/have-black-peoples-lives-improved-after-apartheid-2017-06-20.
Maluleke, R., 2024. Quarterly Labour Force Survey (QLFS) Q1:2024 [Internet] [cited 2024 Jul 23]. Available from: https://www.statssa.gov.za/publications/P0211/Presentation%20QLFS%20Q1%202024.pdf.
Marti-Pastor, M., Perez, G., German, D., Pont, A., Garin, O., Alonso, J., et al., 2018. Health-related quality of life inequalities by sexual orientation: results from the Barcelona health interview survey. In: Devleesschauwer, B. (Ed.), PLOS ONE, vol. 13, e0191334, 1.
Mhlana, S., 2023. Precarious work and the gendered individualisation of risk in the South African manufacturing sector, 2002–2017. Glob Labour J 14 (2) [cited 2024 May 14]. https://mulpress.mcmaster.ca/globallabour/article/view/5098.
Minister of Women, Youth, and Persons with Disabilities, 2022. National Council on Gender-Based Violence and Femicide Bill [Internet]. Sect. 75, 31–2022 Sep. 30. https://www.parliament.gov.za/storage/app/media/Bills/2022/B31_2022_National_Council_on_Gender_Based_Violence_and_Femicide%20Bill/B31_2022_National_Council_on_Gender_Based_Violence_and_Femicide%20Bill.pdf.
Mizobuchi, H., 2014. Measuring world better life frontier: a composite indicator for OECD better life index. Soc. Indicat. Res. 118 (3), 987–1007.
Mkhize, S.P., Maharaj, P., 2020. Structural violence on the margins of society: LGBT student access to health services. Agenda 34 (2), 104–114.
Modiba, M., Mkhize, S.P., 2022. Changes in socio-economic characteristics of formal and informal workers in Gauteng, South Africa. South Afr J Demogr 22 (1), 126.
Møller, V., 2007. Quality of life in South Africa – the first ten years of democracy. Soc. Indicat. Res. 81 (2), 181–201.
Møller, V., Roberts, B.J., 2017. South African hopes and fears twenty years into democracy: a replication of hadley cantril's pattern of human concerns. Soc. Indicat. Res. 130 (1), 39–69.
Moolman, B., 2013. Rethinking 'masculinities in transition' in South Africa considering the 'intersectionality' of race, class, and sexuality with gender. Afr. Ident. 11 (1), 93–105.
Muller, A., 2014. Professionalism is key in providing services to lesbian, gay, bisexual, transgender and intersex South Africans. SAMJ South Afr Med J 104 (8), 558–559.
Mwambene, L., Wheal, M., 2015. Realisation or oversight of a constitutional mandate? Corrective rape of black African lesbians in South Africa. Afr. Hum. Right Law J. 15 (1), 58–88.
Naidoo, Y., de Kadt, J., 2021. GCRO Quality of Life Survey 6 (2020/21): Quality of Life Index Methodology. Gauteng City-Region Observatory (GCRO), Johannesburg.
Naidoo, D., Cloete, A., Skinner, D., Savva, H., Daniels, D., Kose, Z., et al., 2024. "You get HIV because there is no hope" a rapid qualitative assessment of the HIV vulnerabilities of transgender women in three South African metros. Int J Transgender Health 0 (0), 1–16.
National Planning Commission, 2012. National Development Plan 2030: Our Future-Make it Work [Internet]. Available from: https://www.gov.za/sites/default/files/gcis_document/201409/ndp-2030-our-future-make-it-workr.pdf.
Ndinda, C., Ngandu, S., 2016. Winners and Losers: Gender Disparities in the South African Labour Market [Internet]. Human Sciences Research Council. Available from: https://repository.hsrc.ac.za/bitstream/handle/20.500.11910/9714/9217.pdf?sequence=1&isAllowed=y.
Neethling, A., 2021. Quality of Life Survey 6 (2020/21): Weighting Report. Gauteng City-Region Observatory (GCRO), Johannesburg.
Nel, J.A., Judge, M., 2008. Exploring homophobic victimisation in Gauteng, South Africa: issues, impacts and responses. Acta Criminol Afr J Criminol Vict. 21 (3), 19–36.
Nyeck, S.N., Debra, S., Sehoole, J., Ngcobozi, L., Conron, K.J., 2019. The Economic Cost of LGBT Stigma and Discrimination in South Africa. UCLA: The Williams Institute.
Rural Development and Land Reform, 2017. Land audit report. Phase II: private land ownership by race, gender, and nationality [internet]. Available from: https://www.gov.za/sites/default/files/gcis_document/201802/landauditreport13feb2018.pdf.
SAnews.gov.za, 2024. President Ramaphosa Signs GBV, NPA Bills into Law | SAnews. South African Government News Agency (SAnews) [Internet] [cited 2024 Aug 1]; Available from: https://www.sanews.gov.za/south-africa/president-ramaphosa-signs-gbv-npa-bills-law.
Sarno, E.L., Newcomb, M.E., Feinstein, B.A., Mustanski, B., 2020. Bisexual men's experiences with discrimination, internalized binegativity, and identity affirmation: differences by partner gender. Arch. Sex. Behav. 49 (5), 1783–1798.
Satoh, S., Boyer, E., 2019. HIV in South Africa. Lancet 394 (10197), 467.
Sithole, S., 2015. Challenges faced by gay, lesbian, bisexual and transgender (glbt) students at a South African university. TD J Transdiscipl Res South Afr 11 (4), 193–219.
Smale, B., Hilbrecht, M., 2016. Mapping the Canadian Index of Wellbeing to the United Nations Sustainable Development Goals. Can Index Wellbeing Univ Waterloo.
Spieth, P.M., Kubasch, A.S., Penzlin, A.I., Illigens, B.M.W., Barlinn, K., Siepmann, T., 2016. Randomized controlled trials – a matter of design. Neuropsychiatric Dis. Treat. 12, 1341–1349.
Stanley, K., 2007. Design of randomized controlled trials. Circulation 115 (9), 1164–1169.
Statistics South Africa, 2020. Quarterly labour force survey [internet] [cited 2024 Jul 23]. Report No.: P0211. Available from: https://www.statssa.gov.za/publications/P0211/P02114thQuarter2020.pdf.
Statistics South Africa, 2022a. Census 2022: Stastistical Release [Internet]. Statistics South Africa [cited 2024 Jul 3]. Report No.: P0301.4. Available from: https://census.statssa.gov.za/assets/documents/2022/P03014_Census_2022_Statistical_Release.pdf.
Statistics South Africa, 2022b. Labour Market Dynamics in South Africa, 2022 [Internet]. Statistics South Africa, Pretoria, South Africa [cited 2024 Jul 3] p. 176. Report No.: 02-11-02 (2022). https://www.statssa.gov.za/publications/Report-02-11-02/Report-02-11-022022.pdf#page=14.07.
Statistics South Africa, 2022c. National poverty lines [internet] [cited 2024 Jul 23]. Report No.: P0310.1. Available from: https://www.statssa.gov.za/publications/P03101/P031012022.pdf.
Statistics South Africa, 2023. Sustainable Development Goals: Country Report 2023.
Statistics South Africa, 2024. Mid-year Population Estimates [Internet]. Statistics South Africa, South Africa [cited 2024 Aug 12]. Report No.: P0302. Available from: https://www.statssa.gov.za/publications/P0302/P03022024.pdf.

Sulla, V., Zikhali, P., Cuevas, P.F., 2022. Inequality in Southern Africa : an Assessment of the Southern African Customs Union (English) [Internet]. World Bank Group, Washington (DC) [cited 2024 May 14]. Available from: https://documents.worldbank.org/en/publication/documents-reports/documentdetail/099125303072236903/P1649270c02a1f06b0a3ae02e57eadd7a82.

The Organisation for Economic Co-operation and Development [OECD], 2011. How's Life?: Measuring Well-Being [Internet]. OECD [cited 2024 Jun 5]. (How's Life?). Available from: https://www.oecd-ilibrary.org/economics/how-s-life_9789264121164-en.

The United Nations, 2023. Nelson Mandela International Day [Internet]. United Nations [cited 2024 May 14]. Available from: https://www.un.org/en/events/mandeladay/un_against_apartheid.shtml.

The Whoqol Group, 1998. Development of the world health organization WHOQOL-BREF quality of life assessment. Psychol. Med. 28 (3), 551–558.

Twisk, J., Bosman, L., Hoekstra, T., Rijnhart, J., Welten, M., Heymans, M., 2018. Different ways to estimate treatment effects in randomised controlled trials. Contemp Clin Trials Commun 10, 80–85.

VanderWeele, T.J., Mathur, M.B., 2019. SOME desirable properties of the bonferroni correction: IS the bonferroni correction really SO bad? Am. J. Epidemiol. 188 (3), 617–618.

Weisstein EW. Bonferroni Correction [Internet]. Wolfram Research, Inc.; [cited 2024 Jul 23]. Available from: https://mathworld.wolfram.com/.

Weldon, S.L., Htun, M., 2013. Feminist mobilisation and progressive policy change: why governments take action to combat violence against women. Gend. Dev. 21 (2), 231–247.

Wooldridge, J.M., 2007. Inverse probability weighted estimation for general missing data problems. J. Econom. 141 (2), 1281–1301.