Exploring urban health in Cape Town, South Africa: an interdisciplinary analysis of secondary data

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ABSTRACT

Background: With modern information technology, an overwhelming amount of data is available on different aspects of societies. Our research investigated the feasibility of using secondary data sources to get an overview of determinants of health and health outcomes in different population strata of Cape Town, a large city of South Africa.

Methods: The methodological approach of secondary-data analysis was similar in the different disciplines: Biological Anthropology, Public Health, Environmental Health, Mental Health, Palliative Care, Medical Psychology and Sociology at the University of Freiburg and Public Health at the University of Cape Town. The teams collected information on Cape Town through Internet searches and published articles. The information was extracted, analyzed, condensed, and jointly interpreted.

Results: Data show the typical picture of a population in epidemiological and demographic transition exposed to often difficult social, mental, and physical environmental conditions. Comparison between low and higher socioeconomic districts demonstrated that the former had higher air pollution, poorer water quality, and deficient sanitary conditions in addition to sub-optimal mental health services and palliative care.

Conclusion: Although important information gaps were identified, the data draw attention to critical public health interventions required in poor health districts, and to motivate for pro-equity policies.

KEYWORDS

Urban health; Cape Town; interdisciplinary

Background

Today, 54% of the world's population lives in urban areas and urban population growth has been exponential over the last decades [1]. Urban health has therefore become increasingly important for politicians, public health managers, and researchers. 'Urban health' is a concept of analyzing a variety of urban variables e.g. ecological, biological, psychological, behavioral, and economic factors as determinants of health [2]. The interrelationship of these factors and the health outcomes (e.g. morbidity and mortality rates) are the main focus of urban health research.

The Social Determinants of Health (SDOH) Model [3,4] is an approach commonly used in public health epidemiology to describe possible risk factors for a community's physical, mental, social, and environmental health or, in general terms, its well-being. This model focuses on the economic, social, and environmental conditions under

which people live and on the systems factors influencing health. The SDOH are shaped by public policy and economic constraints. Urban health research aims to contribute to the overall goal of health equity and health for all as a human right.

The here presented work as part of our research programme 'Urban Health – Urban Living' aims to better understand the health issues, particularly those of vulnerable population groups (infants, deprived populations, mentally ill people, and patients with terminal diseases), the response of the health system, and the associated environmental factors in urban settings. We therefore analyzed a city in a Middle Income Country where it was assumed large sets of relevant data would be readily available to obtain an overview of the urban health complex and the determinants of health. The SDOH Model [3,4] was modified and used as a conceptual framework (Figure 1).

Figure 1. Social determinants of health (SDOH) (modified) [4].

Under the coordination and leadership of the Freiburg University's Center for Medicine and Society (ZMG), five disciplines (see below) worked together in collaboration with the School of Public Health and Family Medicine, University of Cape Town, South Africa, to identify vulnerable population groups and urban health risk factors including services delivery issues through analysis of secondary data available on the Internet and published articles. As health is more than the mere absence of disease [5], an interdisciplinary approach was used to identify underlying and influencing SDOH in the city of Cape Town.

The general objective of the project was to identify major 'health and health services gaps' through secondary data analysis in the city of Cape Town. The specific objectives were:

- (1) To describe determinants of health in the city (e.g. contextual factors such as geographical, demographic, and socioeconomic characteristics), as well as in a district with poorer and another with more favourable socioeconomic conditions
- (2) To identify risk factors for poor health in different age groups and population strata including social and physical environmental variables
- (3) To analyze aspects of health care regarding a) the availability of health services to the general population and specialized care, b) for mental health problems, and c) for terminal ill patients (palliative care) The disciplines contributing to the project were:
 - (a) *Public health*: Analysis of general health status and risk factors.
 - (b) *Biological anthropology*: Special focus on mother and child health (a particularly vulnerable group, mentioned in the United Nations Millennium Development Goals Nos. 4 and 5 [6,7] and the Sustainability Development Goal No. 3 [8]), which strongly underlies adaptive evolutionary

processes and is especially relevant in fast developing urban environments. In particular, growth indicators, e.g. child's growth, are seen as a 'mirror' of health [9].

- (c) *Environmental health*: Air and drinking water quality as well as sanitary conditions strongly influence the health status of urban populations. Environmental Health Indicators (EHIs) help to quantify the environmental pressure on a population and they describe the link between the environment and health outcomes.
- (d) *Mental health*: Urban environments contain both health risks and benefits, whereas mental health is often negatively affected [10]. There is an increased risk of mental disorders among urban inhabitants [11]. Mental health has evolved into an important public health issue in South Africa [12] in response to which new policies have been introduced and legislative developments taken place in South Africa. The research focus was therefore on the availability and quality of mental health services.
- (e) *Palliative care (PC)* is an approach for care of patients with terminal and life-threatening diseases [13]. It is estimated that fewer than 5% of people in Africa who are in need of PC actually receive it and that the need for appropriate PC in sub-Saharan Africa will increase due to the growing burden of cancer and HIV/AIDS [14]. Due to the paucity of published data on the infrastructure and quality of PC and hospice care in South Africa, our focus was on the availability and quality of PC services.

To ensure high methodological standards and homogeneity, a quality assurance approach was utilized, with methodological support by Medical Psychology and Sociology. This approach to conducting research by a team of diverse professional backgrounds serves to promote a shared understanding of the ways of thinking [15].

Methodology

Study site

The City of Cape Town in the Middle Income Country South Africa was selected as it was expected that sufficient information for the purpose of this study would be available.

Cape Town is the second most populous urban area in South Africa [16]. It is the legislative capital of South Africa. The City of Cape Town is subdivided into different sectors. For our analysis, we focused on the eight health districts with different socioeconomic and environmental characteristics (Figure 2). The City has an area of 2,461 km² and a population of 3,740,025 people, the population density being 15,197 people per km² [16].

Methods

Following the SDOH model (Figure 1) information regarding the different groups of determinants was collected between November 2014 and December 2015 in eight districts of the City of Cape Town such as on demographic and socioeconomic characteristics, the health services, health indicators, living conditions, life style factors, and others.

Information from South African and City of Cape Town governmental websites and reports (Statistics South Africa, Department for Sanitation and Water Affairs, Department of Health) and the websites of relevant stakeholder associations and institutions were screened (African Centre for Cities, South African Hospice and Palliative Care Association). The search strategies, data extraction, key words, key indicators, and selection process applied by each discipline are summarized in Table 1.

Additionally, an electronic search of databases including PubMed, MedLine, and PsychInfo was conducted particularly by the mental health team as they did not find sufficient information on the above mentioned data platforms (systematic review to be published separately by the mental health team). Inclusion criteria were: information source not

older than 1997, English or German language, information relevant for our study objectives. Excluded were general overview articles and interpretative texts without specifying the information source. Additional inclusion/exclusion criteria for mental health and palliative care are presented in Table 1. Articles that met the inclusion criteria for each discipline were extracted on spreadsheets, analyzed and shared among the participating disciplines and jointly interpreted in monthly interdisciplinary team meetings.

Ethical aspects

Ethical clearance was provided by the University of Freiburg (Number 239/15 16 June 2015) and from the Human Research Ethics Committee (HREC) in Cape Town (Number: 335/2015 06 July 2015).

Results

General information on Cape Town and health conditions in different districts

In order to describe the geographical, demographic, and socioeconomic characteristics of the city and its different health districts, we compared the eight health

Table 1. Summary of methods according to each discipline.¹

Item	Public health/biological anthropology (joint analysis)	Environmental health	Mental health	Palliative care (PC)
Objective(s) covered	Objective 1 (contextual factors) Objective 2 (risk factors for mother and child health) Objective 3 (health care system)	Objective 2 (Environmental risk factors)	Objective 3 (Service factors, mental health care)	Objective 3 (Service factors)
Search strategy and data extraction	Sources: Homepages city of CT, Western Cape Government, PubMed, Google Scholar, Saving Babies, Saving Mothers	Sources: Homepages city of CT, Western Cape Government, South African Gove, Department Water & Sanitation, PubMed	Sources: Systematic literature review. PubMed and PsychInfo. Databases from January 1997 onwards	Sources: PubMed, , Homepage of Hospice and Palliative Care Association of South Africa and Western Cape Government
Key words	For objective 1 & 2: Cape Town, South Africa, children health, neonatal health, child growth, infant mortality, weight-for-height growth, Drakenstein child health study, smoking during pregnancy, fetal alcohol syndrome, pregnancy, mother health, infant development, maternal health	Air Pollution, Indoor Air Pollution, waste management/pollution, drinking water quality, sanitation, road traffic accidents, Environmental Health Indicators, Cape Town, South Africa	Mental health services, mental health systems, mental health structures, mental health care and Cape Town	Palliative Care, Hospice Care, end-of-life-care, terminal care", South Africa, Cape Town
Key Indicators	Mortality rates for infants, children, mothers Top 3 causes of death; existing health facilities	Environmental health indicators (EHIs): ambient and household, air pollution, water and sanitation, disposal, road traffic accidents	Availability, Accessibility Acceptability of mental health services Mental health status	Status of PC infrastructure, existing health policy, existing PC education and research, opioid availability
Selection process and information obtained	Information on mother-child-unit sought but mostly information on either children or mothers obtained; focus: neonatal outcome, mortality rates, morbidity rates and growth of children. 562 articles were identified; 66 cohort studies with children at different ages in SA (most of them covering single age groups or small and selected sample populations, none of them providing disaggregated data). 15 cohort studies on Cape Town children	Information on environmental indicators provided by official statistics. Studies and publications on environmental status and its association with health outcomes in Cape Town	A total of 326 articles identified; 208 were excluded after screening titles and abstracts (71 articles contained no reference to CT, no mental health issues, no structural aspect of mental health care). 42 articles met the inclusion criteria (included information about Cape Town and addressed issues concerning the local mental health care structure)	Pubmed: Exclusion criteria: paediatrics, focus on pharmaceutical and medical products and interventions. Inclusion criteria: papers describing PC services and infrastructure, PC education/research/ key concepts for improvement Dropbox: search for 'pall', 'terminal', 'frail' and 'hospice'

¹All data available was collected in a Dropbox (= Company for Cloud Storage (www.dropbox.com)) to share with all participating disciplines.

Figure 3. General information of the city of Cape Town (IMR = Infant Mortality Rate; U5MR = Children Under 5 Mortality Rate; 45q15 = Adult Mortality Rate; MMR = Maternal Mortality Rate).

Table 2. Prevalence of stunting (chronic malnutrition) and wasting (acute malnutrition) in South Africa 2012 [25].

Age	Boys		Girls	
	% stunted	% wasted	% stunted	% wasted
0–3 years	26.9	3.8	25.9	1.5
4–6 years	13.5	2.6	9.5	1.0
7–9 years	10.0	2.4	8.7	1.2
10–14 years	15.2	5.6	10.1	2.5

districts of the City of Cape Town with respect to demographic, socioeconomic, and health outcome variables using data from the Census 2011 [16] and the Western Cape Mortality Profile 2011 [17] (see Figure 2). Then, we selected one better-off and one more disadvantaged (poor) district for further analysis and – wherever possible – for comparison. The selection criteria available across all districts were under-five mortality (as a general

Figure 4. General information of the health district Khayelitsha of the city of Cape Town (IMR = Infant Mortality Rate; USMR = Children Under 5 Mortality Rate; 45q15 = Adult Mortality Rate; MMR = Maternal Mortality Rate).

health indicator associated with poverty) and population density (crowding associated with poverty).

When comparing the general information on Cape Town (Figure 3) with Khayelitsha, a more deprived health district (Figure 4) and Western District, a more developed health district (Figure 5), risk factors and health outcomes in relation to socioeconomic status become evident.

In the poorer district (with almost exclusively a black African population and lower income levels) compared to the better-off district (with a mixed black-colored-white population and higher income levels)

- the population density (crowding) is much higher (8,964 vs. 709 persons/km²)

Table 3. Ambient air pollutants and their effects on health in Cape Town, South Africa [42,43].

Ambient air pollutants	Health effects	Association between ambient air pollution and mortality rates in the City of Cape Town
<i>Particulate matter (PM₁₀)</i> Particles that are sufficiently small to penetrate thoracic regions matter	Causes Chronic Obstructive Pulmonary Disease (COPD), cardiovascular diseases and asthma, increases risk for myocardial infections; causes lung and systematic inflammation, endothelial and vascular dysfunction, increases incidence of infections, causes pulmonary cancer.	An interquartile range (IQR) increase of PM ₁₀ (12 µg/m ³) significantly increased CBD mortality in Cape Town by 4%. In the warm period, high PM10 levels in Cape Town were significantly associated with RD and CVD mortality.
<i>Ozone (O₃)</i> O ₃ and its precursors are associated with an unusual smog pollution ('brown haze') in Cape Town area [44,45]	Pulmonary and cardiovascular systems affected with increased morbidity and mortality.	From the secondary data sets no evidence is available on the association between O ₃ levels and health effects.
<i>Nitrogen dioxide (NO₂)</i> Precursor of secondary pollutants, e.g. nitrate and sulfate; key initiator of photochemical formation of O ₃ .	Changes in lung structure, lung function and lung metabolism, decreased defense against bacterial infection, especially children have increased risk of respiratory illness, increased airway responsiveness to bronchoconstrictors, especially for asthmatics	An interquartile range (IQR) increase of NO ₂ (12 µg/m ³) significantly increased CBD mortality in Cape Town by 8%, an IQR increase of NO ₂ (8 µg/m ³) over the entire year led to a significant 3% increase in CVD mortality. In the warm period, NO ₂ levels are significantly associated with CBD, RD and CVD mortality.
<i>Sulfur dioxide (SO₂)</i> Colorless, pungent gas; condensation of the gas contributes to PM	Wheezing, shortness of breath, changes in pulmonary function and respiratory functions in asthmatics.	An IQR increase of SO ₂ (8 µg/m ³) over the entire year led to a significant 3% increase in CVD mortality. In the warm period, high levels of SO ₂ are associated with CVD mortality.

Note: A case-crossover study from Wichmann and Voyi [31] found significant associations between daily respiratory (RD), cardiovascular (CVD) and cerebrovascular (CBD) mortality and ambient air pollution in Cape Town in the years 2001–2006.

- the life expectancy at birth is 7 years lower (65.7 years vs. 72.0 years)
- the population pyramid has a broader basis (pointing to a higher fertility rate and higher infant- and under-five-mortality) but has a similar shape
- infectious diseases (particularly HIV/AIDS and tuberculosis) have a higher prevalence in the poor district vs. non-communicable diseases in the better-off district
- interpersonal violence as cause of death is higher (14.3 vs. 4.6% of all deaths)
- infant mortality rate (IMR) is higher (19.6 vs. 16.2 per 1000 live births)
- under-five mortality rate (U5MR) is higher (24.6 vs. 19.2 per 1,000 live births)
- district-specific maternal mortality ratio data are regarded as unreliable as these are mainly based on hospital statistics (hospitals mainly outside the poor district, access to hospital differs selectively, hospital population does not mirror resident population of the district)

Among the risk factors for increased morbidity and mortality [18] are:

- High unemployment rate in the poor district compared to the better-off one (38.0 vs. 11.3%) particularly among black Africans (38.3 vs. 16.4%).
- The average monthly income in the poor district is lower, more people on the lower end of the income distribution (< R6400) while it is quite evenly distributed in the richer district.
- Housing conditions are poorer (around 60% of families with 'formal' dwellings in the poorer district and almost 100% in the richer district)
- Indoor toilet facilities and/or piped water are much more restricted in the poor district compared to the

better-off district (roughly 40 to 60% of homes with indoor toilets and piped water vs. roughly 100%).

- Availability of health facilities (in terms of facilities per population) is more limited in the poor district (0.28 vs. 0.55 health facilities per 10,000 people).

When looking at the higher aggregation level (Cape Town, Figure 3), the differences are leveled out and the characteristics of a Middle Income Country at the stage of epidemiological transition appear: declining fertility and infant mortality rates over the last 25 years (as expressed by the population pyramid), moderate IMR (17.5 per 1000 live births), and life expectancy at birth (67.1 years) with acceptable levels of private facilities (formal dwellings) and piped water/toilet facilities and consequently non-communicable diseases (cardiovascular diseases) on top of the mortality statistics [19,20].

Health and risk factors of children and mothers

Studying the health of children is an important focus in Biological Anthropology with the aim of drawing attention to recent global health developments and also to better understand long-term evolutionary dynamics which contribute to shape population-level vulnerabilities and coping capacities [24,25]. This understanding may help to adapt implementation programs in an effective way to avoid and reduce stunted growth, developmental retardations, and susceptibility to infectious and chronic disease. Causal explanations of poor child health include a diversity of risk factors but also parents and families as a major influencing system [26,27]. Especially the mother-child interactions have been recognized in evolutionary anthropology as critical for the development of population health, shaping the population pyramid, and major demographic parameters [28]. Dissolving family ties and

Figure 5. General information of the health district of Western of the city of Cape Town (IMR = Infant Mortality Rate; U5MR = Children Under 5 Mortality Rate; 45q15 = Adult Mortality Rate; MMR = Maternal Mortality Rate).

separating factors such as the mother's work environment, the diversity of neighborhoods, and infrastructure within a city may act as isolating factors [10] strengthening the need for studying mother and child interactions.

In our literature review, we found information on mother and child health at different levels of aggregation.

Whereas considerable information was found for South Africa or the Western Cape province as a whole; less information was available for the City of Cape Town and its health districts. Several cohort and panel studies on child health and contextual data exist for South Africa ($n = 66$), however, they either lack accessibility to the

raw data and/or do not supply sufficient information for the interpretation of mother and child health. A single panel concentrating on growth data of Cape Town children exists [29].

The information on infant mortality rates and under-five morbidity rates [16] is presented in the previous section and in Figure 3–5. It shows similarities and differences between disadvantaged and better-off areas. The three top causes of deaths (calculated from data presented in Ref. [17]; own calculations) in infants under age 1 were pre-term birth complications, lower respiratory infections, as well as diarrhea in under-five children. According to the Cape Town death statistics, lower respiratory infections and diarrhea continue to be the major causes of death for children under the age 15. This was the case particularly in the poorer health district of Khayelitsha, which presents a number of the above-mentioned risk factors [23]. The ongoing importance of these diseases of poverty with a trend towards non-communicable diseases in the older age groups (Cerebrovascular Disease, Diabetes) are an expression of the epidemiological transition (from infectious to non-infectious diseases [19]) occurring in Cape Town. Interpersonal violence (especially of males) and HIV/AIDS [19] as the top causes of death in young adults (age 15–24) were more frequent in the poorer district compared to the better-off district as an expression of lower socioeconomic status.

Growth and developmental data are of special interest for assessing child health. WHO Growth Standards – based

on healthy children – are used to monitor the growth and development of South African children [21,22]. In 2012, the highest prevalence of stunting due to chronic malnutrition was found in children under the age of three. In contrast, the highest prevalence of wasting due to acute malnutrition occurred in children aged 10–14 [21] (see Table 2). Unfortunately, disaggregated information for the City of Cape Town or even for city districts is lacking.

Environmental health issues and indicators

The environment exerts a strong influence on human health. Factors like air quality, drinking water quality, sanitary conditions, and the quality of housing are important variables. In this context, the WHO has defined Environmental Health Indicators (EHIs) linking environmental issues with health outcomes. Within the scope of our research, some of these relevant EHIs were investigated in the City of Cape Town based on secondary data sets. The assessment parameters used in this study include air pollution, water quality, access to sanitation, disposal of municipal solid waste, and road traffic accidents.

Ambient air pollution

Between 2003 and 2012, the particulate matter (PM₁₀; particulates with an aerodynamic diameter smaller than 10 µm) daily mean threshold of 50 µg/m³ defined by the UK guideline [30] exceeded by more than 1000 times at all 13 measuring sites (Figure 6). Ambient and indoor

Figure 6. Number of PM₁₀ exceedances per year at various monitoring sites in Cape Town between the years 2003 and 2012 (Values taken from measurement stations reported.) [30]

air pollution, which mainly affects the respiratory and cardiovascular systems, can cause several serious health problems [31].

'Brown haze' has emerged as a prominent pollution problem in Cape Town. Brown haze consists of the primary pollutants PM_{10} , SO_2 , NO_x , H_2S , and volatile organic compounds (VOCs) arising from transportation, industrial processes, fuel (wood and paraffin), windblown dust, and solid waste disposal [32,34]. Brown haze mostly occurs during winter months due to temperature inversions when polluted air is trapped close to the ground; however, recent episodes of brown haze have been occurring in summer too [32]. These pollutants are monitored by an Air Quality Monitoring (AQM) network of 14 stations distributed around the city of Cape Town [33]. The density of analyzers is higher in districts with higher socioeconomic strata like western or northern, compared for example with Khayelitsha. The PM_{10} 24 h values exceeding the threshold ($50 \mu g/m^3$) recorded in Khayelitsha occurred 58–120 times per year (Figure 6). Several values exceeding the corresponding guideline thresholds have also been reported from Cape Town for other pollutants like ozone (O_3), sulfur dioxide (SO_2), and nitrogen dioxide (NO_2), albeit to a lesser extent than PM_{10} [32,33]. A study by Wichmann and Voyer (2012) showed in Cape Town for the years 2001–2006 significant associations between ambient air pollution and daily respiratory (RD), cardiovascular (CVD), and cerebrovascular (CBD) mortality which were in even stronger than reported for high income countries [35].

Figure 6 shows how often the 24 h $50 \mu g/m^3$ PM_{10} guideline threshold of the UK was exceeded per year, reported by the City of Cape Town. Some data might be underestimated due to defaults in air monitoring analyzers and missing data [33].

Indoor air pollution

There are only few studies on indoor air pollution in South Africa, and these are mostly descriptions of access to clean fuel but not direct measurements of indoor air quality [36]. The main factors contributing to indoor air pollution are combustion of solid biomass fuels for heating and cooking on open fires or poor stoves, as well as smoking [37]. Since electricity is considered to be the safest fuel, electrification of households is proposed as an intervention to reduce indoor air pollution. Between 1994 and 2006, many South African households were electrified, and by 2006 73% had access to electricity [36]. In 2011, 94% of Cape Town households were using electricity for lighting, 87.6% for cooking, and 63% for heating [16]. However, because electricity is expensive, many poor informal households continue to burn solid biomass fuel and the use of such unsafe fuel in informal shacks with poor ventilation leads to high levels of air pollution which is strongly associated with Acute Lower Respiratory Infections (ALRI) in young children [36]. There

are no data published by Governmental agencies on indoor air quality in Cape Town.

Water quality, access to sanitation

The City of Cape Town has clean and healthy drinking water and a well-established water quality monitoring system. None of the reported data exceeded SANS 241:2011 specifications regarding physical, chemical, or microbiological determinants [38,39]. Since 2009, all households in formal settlements have had access to basic sanitation services (toilet and tap water); however, some of these toilets have to be used by a large number of people, leading to environmental contamination and spread of diarrheal diseases [40,41]. The Census data also show lack of access to piped water and toilets [16] in informal settlements (see Figure 4).

Disposal of municipal solid waste

Widespread dirt and litter in Cape Town is a major environmental concern with an increased risk of disease transmission particularly in poor neighborhoods. Irregular or lack of waste removal due to municipal outsourcing of solid waste collection is a major contributing factor particularly in areas with informal settlements. Informal rubbish dump areas are also problematic [41].

Road traffic accidents

In South Africa, road traffic fatalities accounted for 9.3% of all non-natural deaths between 2001 and 2006 and the age adjusted road traffic mortality rate for South Africa were about double that of the global rate [42]. The main reasons for this high proportion are unsafe road environments, poor enforcement of existing traffic laws, road rage and aggressive driving, as well as alcohol misuse [42]. In Cape Town, on average, 234 traffic accidents occurred per day in 2005, and the road traffic death rate was 23 per 100,000 people [43]. In 2012, the number decreased slightly to 63,000 crashes with more than 15,000 injured and about 660 persons killed, i.e. a fatal accident rate of 17.8 per 100,000 [44]. For comparison: Germany had 4.4 fatal accidents per 100,000 inhabitants in 2012 [45]. Fifty-seven percent of fatalities in Cape Town were pedestrians [44]. Most accidents occurred in winter (highest rates in May and April) under wet conditions with poor visibility, and most fatal accidents occurred at dusk, dawn, and during the night.

Mental health services

In South Africa, neuropsychiatric disorders ranked third in their contribution to the burden of disease, after HIV&AIDS and other infectious diseases [46]. Mental health has evolved into an important public health issue including depression, anxiety, and substance abuse disorders [12,47]. Accordingly, there have been recent policy and legislative developments with increased emphasis on mental care.

Figure 7. Hospice and Palliative Care Providers in Cape Town identified in online research (elaborated by Eva Hänselmann).

Availability of mental health care services in Cape Town

The majority of patients are seen at the primary health care (PHC) level, which is often underfunded and understaffed [48] and is attended by untrained personnel with respect to mental health literacy. Nurses, doctors or counselors often do not feel competent and confident to treat these patients [49,50]. Aside from people consulting community health centers (PHC clinics), they may decide to go to traditional healers or seek care in specialized psychiatric hospitals [51]. The study by Sorsdahl et al. [52] in Cape Town showed that there are newly introduced interventions into the existing mental health care services but many people needing mental health interventions (particularly for common disorders such as depression and anxiety) were not receiving them [52].

Accessibility of mental health care services

There are huge inequities in the accessibility of mental health services in Cape Town. While services at the PHC level are mainly accessible and usually cost-free, specialist mental health services are difficult to access, especially for deprived communities in informal settlements where mental health issues are particularly important [53]. Furthermore, there is discriminatory access to mental health services for black and colored versus white people, and for female versus male patients (with greater stigma and discrimination for women being barriers to access mental health services). There is also language discrimination as well as barriers for special populations in need such as pregnant women or people living with HIV/AIDS [54,55]. There is low mental health awareness in patients and the community [56–58].

Acceptability of mental health services

Contradictory results were reported concerning acceptability of existing psychiatric services. Some recently introduced changes received fairly high acceptance scores

by service users, but there continues to be widespread stigmatization of mental disorders in the general population. The choice of traditional healers over public mental health services could partially be explained by a perception of existing mental health services as culturally inappropriate or insensitive. Pregnant women and mothers as a vulnerable group with a higher risk of having mental health disorders [58,59] often do not use the services.

Palliative care (PC) services in Cape Town

There was no Cape Town specific information available about existing health policy regarding PC, or about the availability of PC services or PC training. Therefore, reports and research papers on the provincial and national level were consulted to illustrate the situation (objective 3).

The situation regarding PC in southern Africa is difficult. Key challenges are the double burden of infectious and non-communicable diseases, insufficient access to opioids, weak health care systems, and a low level of inclusion of specialist as well as of general PC approaches in the health care structures and policies [60]. Specialist PC Services include inpatient wards, home care services, day care, hospital support teams, education and training interventions, patient support groups, bereavement care, foster parent support groups, orphan support groups, and hospice care for the homeless [61]. South African hospices engage in a very diverse home and community-based care which would be beneficial also for resource-rich countries to learn [62].

Seventeen public and private institutions providing in-patient and/or home-based care to terminally ill patients in the City of Cape Town were identified. The location of hospices and specialist palliative care providers in Cape Town are presented in Figure 7.

In the City of Cape Town, an average of 1,856 formal home carers e.g. nurses, social workers, and volunteers

are appointed by not-for-profit organizations (NPOs) every month. Within the City, the particularly poor health district Khayelitsha, which is described above has two providers and the highest number of formal home carers (average of 326). Within the City, Khayelitsha subdistrict shows the highest rate of appointed home carers with a monthly average of 326 in contrast to e.g. Southern subdistrict with a monthly average of 158 [63]. The education required of such home carers is not explicitly mentioned, but from the context the number presumably includes nurses, social workers and volunteers. Since home-based care workers cannot by law dispense medicines to patients [64], volunteers and non-medical staff probably constitute the majority of the workforce. One of the barriers to adequate palliative care in central and southern Africa including Cape Town is the restricted access to essential pain medications such as opioids [60]. Regarding the availability and consumption of opioids, South Africa has a per capita consumption of morphine of about 4.3 mg (African mean 0.324 mg/capita, global mean 6.27 mg/capita) [65]. The relatively high average consumption per capita may however mask structural inequalities between urban and rural regions, and also between poorer and better-off districts as well as different social groups. However, detailed information on opioid availability in Cape Town or – at a lower aggregation level – in the different Health Districts of Cape Town is lacking.

The University of Cape Town offers broad training, teaching and research opportunities in PC [66] including postgraduate education in Palliative Medicine with practical aspects of delivering palliative care and sensitivity to cultural diversity. This is of great importance since key terms in clinical PC as well as in PC research like ‘pain’ and ‘anxiety’ lack intra – and intercultural equivalence [67]. Also, the language used to speak about death is strongly influenced by cultural aspects: In South Africa, the isiXhosa and isiZulu words for death are avoided in relation to individuals because of the belief that the dead continue to live [68]. This should be and surely is considered in the configuration of models and settings for PC but also in the everyday clinical care provision. Milestones in the forthcoming of African Palliative Care research are the validation of the APCA African Palliative Care Outcome Scale [69,70], a locally validated patient-reported outcome measure to evaluate and improve PC services and the validation of the Missoula Vitas Quality of Life Index for South Africa [71] as well as its ‘derivative’ the Spirit 8, which successfully captured spiritual well-being in African palliative care.

Discussion

Due to funding constraints, the scope of our project is confined to the above-mentioned disciplines limiting the range of our analyses. Particularly Infections Disease Units and working groups on Non-Communicable Diseases will be included in a follow-up project. Methodological limitations were the non-systematic search strategy

(except for mental health), the often restricted quality of documents, the lack of disaggregated information (which would have allowed a more detailed comparison of health districts), and the shortage of analyses addressing specific questions. The information gaps are summarized in Table 4, second column.

A certain amount of relevant health information for children and for women/mothers was available on an individual level of interacting health factors for mothers and their children but very little linked information which would allow analyzing the mother and child complex [28,72]. Furthermore, the mosaic of information does not allow a detailed analysis of health risks for different population strata or to apply a multidimensional risk factor matrix for the health districts which is necessary for a better understanding of the high environmental diversity within the city of Cape Town. In brief: Due to the fast growing urban population Cape Town should be in the focus of population and especially mother and child health studies in order to cope with future challenges but this is not yet reflected in the literature.

Nevertheless, the analysis of the urban health situation and risk factors in the city of a Middle Income Country (Cape Town) using secondary data available on the Internet provided useful information about major health issues, important risk factors, and the inequalities when comparing different urban districts. Main findings are presented in Table 3. They underline the differences between the more deprived compared to the better-off study district in terms of risk factors (housing, sanitation, waste disposal, level of crowding, indoor air pollution, access to mental-physical-palliative care), and health outcomes (increased morbidity and mortality; high incidence/prevalence of infectious disease – particularly diarrheal diseases and vitamin deficiency in children and Tuberculosis and HIV/AIDS in adults). General health risks affecting the whole population largely independent of socioeconomic strata were air pollution and limited road safety.

When applying the Social Determinants of Health Model (Figure 1) information gaps and findings can be grouped in the following way: Not much data were available on individual life style factors (smoking habits, lack of physical activity, unhealthy eating) or cultural habits and many data were not broken down according to gender, age or socioeconomic conditions. But the other determinants which could be analyzed – such as environmental risk factors, living conditions or lack of health and social-care – showed an association with negative health outcomes among disadvantaged population groups.

In summary, our analysis reflected Cape Town as a city of contrasts: deprived vs. well-developed areas, high vs. low population density, high vs. low unemployment rates, poor vs. good housing conditions, and restricted vs. easy access to health facilities. The inequalities identified by our analysis can be grouped into different categories [73]: Inequities regarding

Table 4. Identified information and health gaps in the City of Cape Town through secondary data analysis by discipline.

Discipline	Identified health issues (or 'health gaps')	Information gaps (=missing information)
Public health	<ul style="list-style-type: none"> • High prevalence of HIV/AIDS and tuberculosis, especially in poorer areas • Higher morbidity and mortality rates in poorer health districts • Large differences in housing conditions, access to health facilities, toilet facilities • When comparing poor vs. rich districts • Poor living conditions closely associated with higher morbidity & mortality rates (all ages) 	<ul style="list-style-type: none"> • No data for smaller levels of aggregation than health districts • No link between living conditions and morbidity/mortality rates at individual level
Environmental health	<ul style="list-style-type: none"> • Air quality in some aspects below standard (e.g. high PM₁₀ levels particularly in poor districts) • Cooking/heating/combusting of polluting fuels may lead to pulmonary and heart diseases • Accessibility to adequate sanitation facilities is problematic in poor districts (associated with diarrheal diseases) • Reduced access to piped water and toilet facilities in informal settlements • Waste collection particularly in poor districts and informal settlements inadequate • Informal waste disposal existing in informal settlements (threat to human health) • Poor road safety (high road traffic death rates) 	<ul style="list-style-type: none"> • No actual data of indoor air pollution • Incomplete monthly reports of air pollution data • Frequent analyzer errors • The smaller the level of aggregation the less information is available • No data about noise levels • No data for indoor air pollution • From the secondary data sets little evidence is available on the strength of the association between undesirable EHs and health effects
Biological anthropology	<ul style="list-style-type: none"> • Educational gaps shown for fetal alcohol spectrum disorder, limited breastfeeding, reduced vaccination coverage. • Main childhood diseases reported (e.g. diarrhea, respiratory diseases, lack of vitamin A) but no association with health of mothers analyzed (e.g. acute and chronic maternal diseases such as HIV/AIDS) 	<ul style="list-style-type: none"> • No information on health and socioeconomic situation of mother–child-unit (only separate information on mothers and children) • The smaller the level of aggregation the less information available • Use of WHO growth standards (e.g. in road to health chart) do not fit population (specific growth charts for South African children are missing) • Road to Health Chart often not used by mothers (no detailed information on child growth available) • Pregnancy information (e.g. number of pregnancies, number of children, antenatal visits, marital status, etc.) scarce or missing • Unreliable information on infant mortality rate and maternal mortality ratio; (possible reason: children not registered & death not notified; only mothers who die in hospital are registered) • Often unclear epidemiological study design with questionable results
Mental health	<ul style="list-style-type: none"> • Primary mental care exists but lacks quality • Lack of resources for adequate treatment esp. in the PHC sector • Crucial need to train PHC staff • Multiple inequities in the accessibility of mental health services in CT • Low mental health literacy among patients and community 	<ul style="list-style-type: none"> • Insufficient research on the role of urbanism in the mental health context in Cape Town • Further work on integrating mental health care in the existing primary health care structure is needed • Research on the implementation of newly developed programs and delivery practices are missing
Palliative care	<ul style="list-style-type: none"> • No information on the availability of opioids in the diverse health districts of Cape Town • No involvement of City Health Clinics in provision of PC services • Role of traditional healers in palliative care is ambiguous in the literature • Accessibility and quality of PC services at PC level is limited 	<ul style="list-style-type: none"> • Documents on District Health Policy (on the level of Cape Town Municipality) • Deficient information on delivery practice of palliative care by home and community-based care (HCBS), health facilities and intermediate care providers • No distinction between poor and better-off health districts

- Environmental risk factors (air pollution, poor water and sanitation, poor waste disposal, poor road security)
- Services factors (poor service utilization and/or access to services)
- Health outcomes (morbidity, mortality, life expectancy)

They all point to the need for stronger pro-equity policies in our study city as described in a WHO-UN HABITAT document [74].

It can be concluded that the analysis of secondary data in the public health domain provided an overview of health determinants and health in a large city of a Middle

Income Country which can guide policy-makers towards equity-driven legislations. On the other hand, it was also noticed that important information gaps exist, particularly for the disaggregation of data to health district level. Filling these gaps would enable Public Health Services to define better high risk environments and under-served areas for directing the improvement in the health system.

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