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Insights into the Value of the Market for Cocaine, Heroin and Methamphetamine in South Africa

RESEARCH

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ABSTRACT

The illicit drug trade generates billions of dollars and sustains transnational criminal organisations. Drug markets can destabilise governance and undermine development. Data indicate increasing drug use in South Africa. However, information on the size and value of the drug market is limited. This is the first study to estimate the market value of cocaine, heroin and methamphetamine in South Africa. People who use drugs were meaningfully involved in all aspects of implementation. We used focus group discussions, ethnographic mapping, brief interviews, and the Delphi method to estimate the number of users, volumes consumed, and price for each drug in South Africa in 2020. Nationally, we estimated there to be: 400,000 people who use heroin (probability range (PR) 215,000–425,000) consuming 146.00 tonnes (PR 78.48–155.13) with a value of US$1,898.00 million (PR US$1,020.18–US$2,016.63); 350,000 people who use cocaine (PR 250,000–475,000) consuming 18.77 tonnes (PR 13.41–25.47) with a market value of US$1,219.86 million (PR 871.33–1,655.52) and 290,000 people who use methamphetamine (PR 225,000–365,000) consuming 60.19 tonnes (PR 6.58–10.68) and a market value of US$782.51 million (PR 607.12–984.88). The combined value was calculated at US$3.5 billion. Findings can be used to stimulate engagement to reform drug policy and approaches to mitigate the impact of the illicit drug trade. Additional studies that include people who use drugs in research design and implementation are needed to improve our understanding of drug markets.

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INTRODUCTION

GLOBAL CONTEXT

The illicit drug market is big. In 2013 it was worth $426–652 billion (May, 2017); approximately 0.7% of global gross domestic product (GDP) (Statista 2022). Over the past decade there has been marked growth in the size of the drug market around the world (United Nation Office on Drugs and Crime 2021). Prohibitionist approaches have had little to no meaningful impact on drug supply or demand (The Global Commission on Drug Policy 2021). Despite expenditure of $100 billion a year in an attempt to eradicate the trade, only 1% of laundered drug money is recovered by the authorities (The Global Commission on Drug Policy 2021). Between 2015 and 2019, seizure of opioids and amphetamine type stimulants (ATS) increased more than two-fold, with less marked increases in cocaine seizures (UNODC 2021). In comparison, global production of opium and cocaine roughly doubled over the past two decades and supply has remained relatively stable (UNODC 2021). Paradoxically, efforts to control drug supply (through seizures and drug-related arrests) may increase profitability through reduced competition and increased demand (Bouchard 2007). Flexible and changing transportation solutions are employed by actors involved in the illicit drug trade to mitigate the potential effects that geopolitical events and law enforcement may have on business (UNODC 2015; Eligh 2020, 2021).

Globally, in 2019 an estimated 62 million people used opioids for non-medical purposes, 27 million people used ATS and 20 million people used cocaine (UNODC 2021). Worldwide, the proportion of people who used a drug in the past year (±5%), and the proportion of people who used drugs who had a drug use disorder (± 13%) has remained relatively constant over the past 10 years (UNODC 2021). In 2019, the annual prevalence of cannabis use among people in Africa was 6.4%, and stood at 1.2% for opioids, 0.3% for cocaine, and 0.4% for ATS (UNODC, 2021). Due to Africa's young, growing population and rapid urbanisation the proportion of people who use drugs is expected to increase by 40% by 2030 (UNODC 2021).

DRUG MARKET VALUATION

The valuation of drug markets requires data on volumes and price. However, the criminalised nature of drug use and the drug market complicates valuation. For example, the volume of drugs traded is sometimes calculated by extrapolating police seizure data (Werb et al. 2013). However, porous borders, out-dated technology and corruption enable illicit trade, with seizure data reflecting a small fraction of trade volume (Haysom, Gastrow & Shaw 2018; Machethe & Mofokeng 2022; Stanyard 2022). Importantly, drug seizures are influenced by law enforcement capacity, coordination, and political will (Giommoni, Berlusconi & Aziani 2022), and do not necessarily reflect changes in drug trade volumes.

Furthermore, estimates of the number of people who use drugs are largely lacking or inaccurate (UNODC 2021). Many existing estimates are taken from household surveys. However, sub-populations of people with higher proportions of drug use (e.g., those experiencing homelessness and people in prison) are often excluded from these studies, contributing to an under estimation of the number of people who use drugs (Johnson 2014). Moreover, under reporting of drug use in household surveys is common due to fear of arrest, stigma, and poor questionnaire design (Johnson 2014; Global HIV Strategic Information Working Group et al. 2017). Health service data can provide insights into trends, but it is limited to those who access treatment (UNODC 2021). Drug-related arrest data is also of limited value to assist our understanding of drug demand. Incentives for arrest, the differential likelihood of detention based on demographic and socioeconomic characteristics, and political and legal factors influence policing practices, resulting in biased estimates (Lukas Muntingh 2013; Mooney et al. 2018; Scheibe et al. 2016).

Similarly, it is difficult to assess the amount of drugs consumed. Estimates may be based on data collected through the approaches noted above; however, the data would likely be affected by the same biases affecting other variables.

Drug market valuation estimates are more easily based on consumer price, as wholesale prices are rarely known (European Monitoring Centre for Drugs and Drug Addiction 2019). However, consumer prices may fluctuate and are influenced by purity and the addition of bulking agents (Cole et al. 2011).

Specialised methodologies can overcome the challenges noted above. For example, research conducted in partnership with people who use drugs and trusted organisations using recommended methods (e.g., respondent driven sampling) can be used to recruit people who use drugs and to obtain reliable data (Global HIV Strategic Information Working Group et al. 2017). Novel analytical techniques, such as sewage epidemiology, can be used to assess drug metabolite levels in wastewater to provide empirical insights into the volume of drugs consumed (Huizer et al. 2021).

THE SOUTH AFRICAN CONTEXT

Emerging data point to a large, and growing drug market in South Africa (Eligh 2020). Increasing flows of heroin,[1] cocaine, and methamphetamine have been documented over the past 20 years (Haysom 2019). In 2005, 0.2% and 0.5% of men (aged ≥ 20 years) who participated in a national household survey reported opioid and cocaine use in the past three months, respectively (Peltzer et al. 2010). Programmatic data shows that the proportion of people admitted to drug treatment centres for opioid dependence increased from 16% in 2012 to 20% in 2017 (Harker et al. 2020). A 2017 household survey found that 0.3% of participants (aged ≥ 15 years) reported opioid, cocaine, and amphetamine use in the three months preceding the study (Peltzer & Phaswana-Mafuya 2018). Drug market research reflects a net decrease in the price of heroin, cocaine, and methamphetamine between 2004 and 2014 (Howell et al. 2015).

In light of the increased volume of drugs flowing through the country, and increasing use, it is probable that the illicit drug economy is of significant size and value. However, to our knowledge there is no published data on the value of South Africa's drug market. This study aimed to estimate the retail market value of cocaine, heroin, and methamphetamine in South Africa from a demand side, with meaningful engagement and participation of people who use drugs.

METHODS

The study employed focus group discussions (FGDs), ethnographic mapping, brief interviews, and the Delphi method to gather inputs to estimate the retail drug market value in South Africa in 2020.

SETTING

South Africa has nine provinces and is comprised of 52 districts. Districts are further divided into electoral wards. Fieldwork was conducted in nine South African cities across seven provinces: Bloemfontein (Mangaung District, Free State Province); Cape Town (City of Cape Town District, Western Cape); Durban (eThekwini District, KwaZulu-Natal Province); Johannesburg (City of Johannesburg District, Gauteng Province); Mbombela (Ehlanzeni District, Mpumalanga District); Pietermaritzburg (uMgungundlovu District, KwaZulu-Natal); Pretoria (Tshwane District, Gauteng Province); Polokwane (Capricorn District, Limpopo Province); and Port Elizabeth (Nelson Mandela Bay District, Eastern Cape Province). The most populous city in each selected province was selected for implementation. No cities were included from the North West and Northern Cape Provinces, which do not have metropolitan municipalities and are the third least and least populous provinces. An additional city was included in Gauteng and KwaZulu Natal, Provinces which are the most populous provinces (Statistics South Africa 2011). Brief interviews with people who use drugs were conducted at hotspots (locations where people who use drugs congregate or are accessible) in selected wards in each city/district.

PROCEDURES

Activities took place between May and November 2020. The planning, coordination, and implementation was led by the South African Network of People Who Use Drugs (SANPUD) and researchers affiliated to the University of Pretoria's Community Oriented Primary Care Research Unit. People who use drugs facilitated FGDs and ethnographic mapping activities, conducted interviews, validated the results, and participated in population size estimation workshops.

1 Known locally as nyaope, whoonga, unga, sugars, pinch.

Broadly, the procedures involved: (1) primary data collection (FGDs, mapping and brief interviews with people who use drugs) and validation sessions; (2) population size estimation using the Delphi Method (provincial and national workshops) and (3) market valuation.

1. Primary data collection

National and local stakeholders were informed of the project. In the cities where fieldwork took place, engagements focused on networks of people who use drugs and organisations providing health and harm-reduction services for people who use drugs, men who have sex with men, transgender people, and sex workers (key populations). Engagement activities sought to obtain support for the study. Engagement with other stakeholders (e.g., drug, health, social and law enforcement service providers) was advised by people who use drugs who were from the respective city.

Primary data collection and validation sessions were held in each city. The fieldwork methodology was an adaptation of the Priorities for Local AIDS Control Efforts Toolkit (PLACE) methodology (USAID, PEPFAR and Measure Evaluation 2019) and rapid mapping methodologies used with people who inject drugs (Scheibe et al. 2017) and sex workers (Konstant et al. 2015) in South Africa. Table 1 provides details of primary data collection and validation activities. People who were 18 years and older who self-reported to have used cocaine, heroin, and/or methamphetamine in the past 12 months were eligible to participate. Fieldwork was done sequentially over 3–5 days in each city. Fieldworkers, identified during FGDs, underwent a half-day training on the study, covering: conducting brief interviews with their peers using standard tools; data quality; ethical considerations; safety and COVID-19 mitigation strategies. A total of 111 people received training, of whom 96% (n = 107) were people who use drugs. Activities were piloted in each city before implementation.

At the end of the fieldwork in each city, structured validation sessions were held to reach agreement on (1) the cost of each drug (per gram); (2) average amount (a range, in grams) of each drug used in a 24-hour period; (3) proportion of daily and infrequent (monthly) users of each drug, and (4) population size estimates (for each drug and for people who inject) for the city.

Table 1 Primary data collection activities in each city.

FGDs and mapping	Between 6 and 12 people, purposively sampled for diversity (representing men, women, sex workers, men who have sex with men, and transgender people who use drugs), participated in a FGD at the start of fieldwork. The FGDs followed a structured guide that explored drug usage (methods, frequency, volume) and drug market characteristics (number of users, hotspots, and drug unit cost). The mapping component included the use of stickers to plot drug use hotspots on city maps. FGDs were held in private safe spaces and were co-facilitated by the research coordinator and a person with lived experience of drug use from that city. Information was captured using a FGD guide and written notes. The FGDs each took between two and three hours. The informed consent and FGD guide were in English with translations provided by the co-facilitator.
Brief interviews	Brief interviews were conducted with people who use drugs in locations where people who use drugs congregate or were accessible (hotspots) across diverse areas in each city. Feedback from the FGDs and mapping were used to identify locations to conduct interviews and for fieldwork planning. Based on available time and resources, as many interviews and location visits were done in each city as possible. Teams convened at the beginning and end of each day to plan and reflect on the fieldwork. Working in pairs, the fieldworkers conducted up to 20 brief interviews per day (lasting approximately 10–15 minutes each). The informed consent and questions were in English with translations provided by fieldworkers. Brief interview forms gathered information on: observations (number of people at each location visited: <10; 10–30; 31–50; >50); interviewee characteristics (gender, drug most commonly used [heroin, cocaine, methamphetamine] and peer network size [for each drug]); number of people who use drugs visiting that location at the busiest time (a range); relative proportion of types of drug used and injecting among people visiting that location (none; very few/<10%; few/10–25%; under half/25–50%; over half/50–75%; most/75–100%); the number of people who used heroin, cocaine, and methamphetamine, and people who inject drugs in the neighbourhood/ward.
Validation sessions with people who use drugs	Sessions took place at the end of the fieldwork in each city. FGD participants were invited, as well as up to five people who use drugs who had insights into drug use in that city (Konstant et al. 2015). The research coordinator led the sessions, which were structured and standardised. Clarity around conflicting or missing information was obtained. The research coordinator facilitated a discussion to validate the results and reach agreement on estimates. Data on the most commonly purchased form of each drug, and perceived weight of units of purchase, was obtained in each city. Considering the locations that were visited, the findings were extrapolated to the whole city. The research coordinator facilitated these sessions in English, which each took 2 to 3 hours.

2. Population size estimation of people who use drugs

This process involved a bottom up-approach, building on the city-level estimates from the fieldwork to develop district, then provincial and finally national population estimates.

Provincial workshops: Fieldwork team members, representatives of people who use drugs networks and local stakeholders (including health service providers) participated in virtual provincial estimation workshops. Seven workshops were held. Participants interrogated the city-level estimates from the validation sessions in light of programmatic and research data and their experience. The group reached consensus on district-level estimates and upper and lower plausibility bounds using the Delphi Method (Jorm 2015). This method employs four rounds of facilitated engagement among experts to reach consensus on estimates. Delphi was done virtually using an online voting application (https://pingo.coactum.de/ 2022 – coactum GmbH). Estimates were generated for the number of people who use cocaine, heroin, and methamphetamine, and the number who inject drugs in the respective fieldwork district (reference district). The district-level estimates were then used to generate proportions of people in that district (aged 15–64) who use each drug and those who inject drugs using the most recent (2011) census data (Statistics South Africa 2011).

Provincial workshop participants ordered the districts in their province from the district with the largest population of people who use drugs to the smallest. The population of people who use drugs was based on the province's most commonly used drug. Agreement was reached on the relative size of each district in relation to the reference district in that province. The relevant size was calculated as an adjustment proportion. Adjustment proportions were then applied to the general population estimate (15–64 years) of the districts that were not visited in that province. The same adjustment factor was applied across each drug type. This process resulted in district-level estimates for each drug and for people who inject drugs in the province. All of the district estimates were summed to generate initial national population estimates (point estimates and lower and upper plausibility bounds).

National workshops: The research team convened a virtual national size estimation workshop over two sessions held a week apart. Participants included people who use drugs, key population representatives, development partners, researchers, health workers, social workers, government representatives, and civil society service providers. The first session was used to review the process and participants interrogated the findings of the fieldwork and the initial national population estimates (i.e., the sum of the district-level estimates) in relation to other national-level research (Setswe et al. 2015; UCSF, Anova Health Institute and WHRI, 2015; University of California San Francisco, Anova Health Institute and National Institute for Communicable Diseases 2018) and programmatic data (MRC 2020). During the second workshop, the process, fieldwork findings, and other available data were recapped and the Delphi method was used to obtain revised national population estimates.

3. Retail drug market valuation

The retail market value was calculated by multiplying total annual consumption by price (European Monitoring Centre for Drugs and Drug Addiction 2019). Annual consumption was calculated separately for the population of people who used drugs daily and those who used drugs infrequently (assumed to be once a month). These values were added to estimate total annual consumption. Figure 1 provides the formula used and data inputs.

DATA MANAGEMENT AND ANALYSIS

Procedures, tools, and training were standardised. Trained staff fluent in local languages who had lived/living experience of drug use conducted the activities. Fieldworkers and the research coordinator completed reviews of forms for completeness. Paper forms and written notes were concealed while in the field and securely stored. Neither personal nor detailed location data was captured. Data was consolidated into a single Excel database, exported into Stata v14 (StataCorp, College Station, Texas) for analysis. Summary statistics were generated to describe fieldwork participants and quantitative indicators. The market value was calculated using the formula outlined above.

ETHICAL CONSIDERATIONS

Ethical approval was received from the University of Pretoria's Faculty of Health Sciences Research Ethics Committee (ref. 371/2020). Verbal informed consent was obtained. Participants were reimbursed for their participation ($16 for a FGD and $6 for a brief interview).

Retail market value (per year) = Total annual consumption * Price

Total annual consumption = Σ {(No. of past year's users)U * (Amount used per year)U}

Σ = sum

U = different types of users per type of drug, which was categorised into daily or infrequent (monthly).

No. of past year's users: The best estimates and their corresponding lower and upper plausibility bounds were obtained from the national size estimation consensus process. The proportion of daily and infrequent users was the median estimate obtained from the FGDs and validation session data. These proportions were applied to the population size estimates for each drug to obtain the number of daily and infrequent users of each drug.

Amount used per year: A median amount (in grams) of each drug used in a 24-hour period was calculated based on data from the FGDs and validation sessions. For heroin, this combined all reported routes of administration. The annual amount used by a daily user was calculated by multiplying the daily amount by 365. The annual amount used by an infrequent user was calculated by multiplying the daily amount by 12.

The median price per gram was calculated based on perceived amounts that were purchased by drug users based on data from the FGDs and validation sessions. The price was converted from South African Rands (ZAR) to US dollars ($) (at an exchange rate of ZAR 15.4: $1). No adjustments were made for differences in drug purity.

Figure 1 Formula and data inputs to calculate the retail drug market value (European Monitoring Centre for Drugs and Drug Addiction, 2019).

FINDINGS

FIELDWORK

A total of 135 participants took part in FGDs; 53% (n = 72) were men, 24% (n = 32) worked in the sex industry, and 8% (n = 11) were men who had sex with men. Heroin, cocaine and/or methamphetamine were used by 62% (n = 84), 59% (n = 79) and 24% (n = 33) of FGD participants, respectively. Overall, 897 people who use drugs (603 men, 280 women, and 14 transgender people) participated in brief interviews across 479 locations in 130 wards. Over half the interviewees at hotspots mostly used heroin (59%, n = 533), followed by methamphetamine (22%, n = 197), crack cocaine (15%, n = 133), and powder cocaine (5%, n = 46). People who used heroin had the largest peer network (median of 40 people), and people who used methamphetamine had the smallest (median of 20 people). A total of 144 people who use drugs participated in validation workshops. A validation workshop was not completed in Pietermaritzburg due to logistical complications. Table 2 outlines fieldwork participant characteristics.

FGD participants reported that heroin, crack, and powder cocaine and methamphetamine were available and used in all the cities where fieldwork was conducted. They suggested that most people who use heroin concurrently used stimulants, either methamphetamine (in Cape Town and Port Elizabeth) or crack cocaine in the other cities. FGD participants believed that more than half the people who use heroin inject it, while crack cocaine and methamphetamine are mostly smoked, and powder cocaine snorted. Injecting methamphetamine was reported to be more common when mixed with heroin. However, some people were reported to inject methamphetamine on its own.

Across the cities, an average of 10–30 people were observed at each hotspot where brief interviews were conducted. Generally speaking, interviewees reported that between 25 and 60 people congregated at these locations at their busiest times. Heroin was reported to be used by almost all people at the hotspots, except in Cape Town, where methamphetamine was the most widely used drug. More than 75% of people at the hotspot locations visited in Johannesburg were reported to use crack cocaine. Injecting was reported across the hotspots in all visited cities except for Bloemfontein, although injecting practices were confirmed in the validation session in that city.

RETAIL MARKET VALUATION

The validated estimates for population sizes, proportion of people with daily and infrequent use, amounts used in a day and the cost of each drug arising from the fieldwork are provided in Table 3. Details of the fieldwork districts population proportions are in Supplementary Table S1 and the adjustment factors and the population size estimates for all districts and the initial and revised Delphi national population size estimates are provided in Supplementary Table S2.

For heroin, the district population size estimates ranged from 2,508 people in Bloemfontein/Mangaung District to 95,000 in Johannesburg/City of Johannesburg District. Between 75 and 100% of people were reported to use heroin daily across the districts. Amounts of heroin used by people who smoke/inhale it ranged from 0.4 g a day in Port Elizabeth to 3.75 g a day in Cape Town (median range 0.5 g–2.0 g). Among people who inject heroin, daily amounts were reported to range from 0.2 g in Port Elizabeth to 3 g in Port Elizabeth and Pretoria (median range 0.5 g–1.6 g). The cost of heroin per gram ranged from $8 in Cape Town to $16 in Bloemfontein and Polokwane (median $10 per gram).

For cocaine, the district population size estimates ranged from 900 in Bloemfontein/Mangaung District to 92,500 in Johannesburg/City of Johannesburg District. Between 75 and 100% of crack cocaine users were reported to use it daily in all cities, apart from Bloemfontein where 25–50% of crack users were reported to use it daily. Daily powder cocaine use was reported among 10–25% of people in six cities, with <10% daily use in Bloemfontein and no data obtained for Polokwane or Mbombela. Amounts of reported cocaine used varied across cities. For crack cocaine, this ranged from 0.1 g in Cape Town, Port Elizabeth and Mbombela to 0.8 g a day in Johannesburg (median 0.15 g–0.7 g). For powder cocaine, amounts used per day ranged from 0.5 g in Cape Town, Durban, and Bloemfontein to 5 g in Durban (median range 0.5 g–2 g). The price of cocaine was $65 per gram in all districts apart from Johannesburg and Cape Town, where it was $78 and $81 per gram, respectively (median $65 per gram).

For methamphetamine, the district population size estimates ranged from 646 in Pietermaritzburg/uMgungundlovu District to 190,000 in Cape Town/City of Cape Town District. Daily methamphetamine use was reported among 75–100% of methamphetamine users in all districts apart from Port Elizabeth, where daily use was reported to occur among 50–75% of people who use methamphetamine. Data was not obtained for the frequency of methamphetamine use in Pietermaritzburg. Amounts of methamphetamine reported to be used per day ranged from 0.2 g in Port Elizabeth to 2 g in Cape Town (median range 0.25 g–1.25 g per day). The cost of methamphetamine ranged from $5 per gram in Cape Town to $13 per gram in several other cities (median $13 g per gram).

The national level market value inputs and results are presented in Table 4. For cocaine, 40% of people were assumed to use daily (a rounded down mid-point of the proportion of people reported to use crack cocaine daily (75%) and those that used powder cocaine daily (10%)). The median amount used in a 24-hour period (0.35 grams) was based on crack cocaine. The median cost of a gram of cocaine was taken as $65. For heroin, all people included in the population size estimate were assumed to use 1 g of heroin a day at $10 per gram. For methamphetamine, two-thirds of users were assumed to use daily. The median amount used in 24 hours was assumed to be 0.75 g, at a cost of $13 per gram.

The national population size estimate of the number of people who use heroin was 400,000 (probability range (PR) 215,000–425,000), consuming 146 tonnes (PR 78.48–155.13) of heroin a year with an estimated total annual market value of $1,460 million (PR 785–1 551). The population estimate for people who use cocaine was 350,000 (including 140,000 daily users), consuming 18.77 tonnes of cocaine with a market value of $1,220 million (PR 871–1 656). The number of people who use methamphetamine was estimated at 290,000 (including 217,500 daily users) consuming 60.19 tonnes with a market value of $783 million (PR 607–985).

Table 2 Fieldwork participant characteristics.

CT: Cape Town; DBN: Durban; PMB; Pietermaritzburg; PE: Port Elizabeth; BLM: Bloemfontein; PTA: Pretoria; JHB: Johannesburg; MBO: Mbombela; PLK: Polokwane * details of participants not available.

CITY	CT	DBN	PMB	PE	BLM	PTA	JHB	MBO	PLK	TOTAL
FGD (n)	14	22	17	10	13	13	14	17	15	135
Gender										
Men	7	12	11	5	3	8	8	7	11	72
Women	6	8	5	4	9	5	5	9	3	54
Transgender	1	2	1	1	1	0	1	1	1	9
Sub-groups										
Sex workers	1	6	6	6	2	1	4	6	0	32
Men who have sex with men	0	2	0	7	0	0	0	0	2	11
Drugs used*										
Heroin (smoke/inhale)	2	8	1	1	1	9	8	8	11	49
Heroin (inject)	6	4	2	2	1	5	4	4	7	35
Cocaine (crack)	1	9	3	3	2	11	10	9	13	61
Cocaine (powder)	1	4	4	4	2	1	2	0	0	18
Methamphetamine	7	4	0	5	4	3	3	4	3	33
Brief interviewees (n)	91	85	50	44	80	216	102	131	98	897
Gender										
Men	68	47	29	35	58	161	67	67	71	603
Women	21	37	19	8	19	52	35	62	27	280
Transgender	2	1	2	1	3	3	11	2	0	14
Drugs used*										
Heroin	11	37	36	32	4	208	82	81	74	554
Cocaine (crack)	0	29	10	0	15	18	23	32	6	133
Cocaine (powder)	2	9	4	4	23	1	4	1	0	46
Methamphetamine	76	11	0	14	37	10	16	16	17	197

(Contd.)

CITY	CT	DBN	PMB	PE	BLM	PTA	JHB	MBO	PLK	TOTAL
Peer network size										
Heroin users (median)(IQR)	20 (15 –50)	90 (21 –300)	33 (15 –60)	15 (6 –40)	1 (0–9)	50 (30 –100)	100 (45 –300)	30 (10–80)	40 (23 –100)	40 (15 –100)
Cocaine users (median)(IQR)	5 (0 –35)	100 (30 –400)	30 (15 –100)	1 (0 –18)	13 (2 –20)	30 (10 –60)	95 (28 –300)	26 (15 –100)	20 (12 –30)	26 (10 –80)
Methamphetamine users (median)(IQR)	100 (60 –250)	25 (5–75)	0 (0 –20)	50 (21 –92)	15 (7–45)	10 (4 –30)	50 (15 –100)	5 (1 –12)	19 (10 –50)	20 (5 –60)
Validation session (n)	14	22	0	40	13	14	14	9	18*	126
Gender										
Men	7	12		20	8	8	8	7		70
Women	6	8		9	5	5	5	2		40
Transgender	1	2		11	0	1	1	0		16
Sub-groups										
Sex workers	1	6		5	1	4	4	0		21
Men who have sex with men	0	2		0	0	0	0	0		2
Drugs used*										
Heroin (smoke/inhale)	2	8		6	9	8	8	7		48
Heroin (inject)	6	4		3	5	4	4	5		31
Cocaine (crack)	1	9		6	11	10	10	5		52
Cocaine (powder)	1	4		4	1	2	2	1		15
Methamphetamine	7	4		5	3	3	3	4		29

Table 3 District-level estimates (fieldwork districts): population size estimates, frequency and amounts used and unit cost per drug, by city.

CT: Cape Town; DBN: Durban; PMB; Pietermaritzburg; PE: Port Elizabeth; BLM: Bloemfontein; PTA: Pretoria; JHB: Johannesburg; MBO: Mbombela; PLK: Polokwane

- no data collected for this variable.

	CT	DBN	PMB	PE	BLM	PTA	JHB	MBO	PLK
HEROIN									
Estimate for visited wards	12,643	6,332	650	3 545	236	22,875	19,795	5,873	4,365
District estimate (#)	65,000	60,000	3,000	7,000	2,508	45,000	95,000	16,500	5,000
District estimate (%)	0.023	0.023	0.004	0.008	0.005	0.019	0.027	0.014	0.006
% Daily use	75–100%	75–100%	75–100%	75–100%	75–100%	75–100%	75–100%	75–100%	75–100%
Grams used per day									
Heroin (smoke/inhale)	1.25–3.75	0.6–3.0	0.5–2.5	0.4–1.6	0.5–1.5	0.6–1.6	0.5–2.0	1–2.5	0.5–2.0
Heroin (inject)	0.6–2.0	0.6 – 2.4	0.4–1.0	0.2–3.0	0.5 – 1.5	0.6–3.0	0.5–1.0	0.4 – 1.2	0.6 – 1.6
Cost per gram (USD)	8	10	10	10	16	10	10	12	16
COCAINE	**CT**	**DBN**	**PMB**	**PE**	**BLM**	**PTA**	**JHB**	**MBO**	**PLK**
Estimate for visited wards	7,357	6,750	1,027	32	612	5,068	13,665	4,340	769
District estimate (#)	92,500	50,000	3,000	10,000	900	37,500	35,000	3,000	11,000
District estimate (%)	0.032	0.019	0.004	0.012	0.002	0.016	0.01	0.003	0.014
% Daily use									
Crack	75–100%	75–100%	75–100%	75–100%	25 – 50%	75–100%	75–100%	75–100%	75–100%
Powder	10–25%	10–25%	10–25%	10–25%	< 10%	10–25%	10–25%	–	–
Grams used per day									
Crack	0.1–0.5	0.15–0.55	0.15–0.5	0.1–0.55	0.2–0.75	0.2–0.75	0.15–0.8	0.1–0.7	0.15–0.6
Powder	0.5–2	0.5–5	0.5–2	1–2	0.5–2	1–4	1–3	–	–
Cost per gram (USD)	81	65	65	65	65	65	78	65	65
METHAMPHETAMINE	**CT**	**DBN**	**PMB**	**PE**	**BLM**	**PTA**	**JHB**	**MBO**	**PLK**
Estimate for visited wards	32,745	2,073	492	725	1,091	2,190	8,620	1,527	2,823
District estimate (#)	190,000	5 000	646	22,500	1,350	15,000	19,000	1,307	7,000
District estimate (%)	0.066	0.002	0.001	0.027	0.003	0.006	0.005	0.001	0.009
% Daily use	75–100%	50–75%	–	50–75%	75–100%	75–100%	75–100%	75–100%	75–100%
Grams used per day	0.25–2.0	0.5–1.5	–	02.5–1.25	0.25–1.6	0.5–1.25	0.25–1.25	0.2–1	0.2–1
Cost per gram (USD)	5	10	–	13	–	13	13	13	13
PEOPLE WHO INJECT	**CT**	**DBN**	**PMB**	**PE**	**BLM**	**PTA**	**JHB**	**MBO**	**PLK**
District estimate (#)	4,750	4,000	1,000	2,000	559	15,000	15,000	1,625	2,250
District estimate (%)	0.002	0.001	0.001	0.002	0.001	0.006	0.004	0.001	0.003

	HEROIN	COCAINE[1,2]	METHAMPHETAMINE
Market value inputs			
% Daily use	100%	40%	75%
Grams used per day	1.0	0.35	0.75
Cost per gram ($)[3]	10	65	13
Population size			
Daily users, best estimate (PR)	400,000 (215,000–425,000)	140,000 (100–190,000)	217,500 (168,750–273,750)
Infrequent users, best estimate (PR)	0 (0)	210,000 (150,000–285,000)	72,500 (56,250–91,250)
Total, best estimate (PR)	400,000 (215,000–425,000)	350,000 (250,000–475,000)	290 000 (225,000–365,000)
Volume consumed (annually) (tonnes)			
Daily users, best estimate (PR)	146.00 (78.48–155.13)	17.89 (12.78–24.27)	59.54 (46.20–74.94)
Infrequent users, best estimate (PR)	0 (0)	0.88 (0.63–1.20)	0.65 (0.51–0.82)
Total	146.00 (78.48–155.13)	18.77 (13.41–25.47)	60.19 (46.70–75.76)
Market value (US$ millions) (rounded to closest million)			
Daily users, best estimate (PR)	1,460 (785–1 551)	1,163 (830–1 578)	774 (601–974)
Infrequent users, best estimate (PR)	0 (0)	57 (41–78)	8 (7–11)
Total, best estimate (PR)	1,460 (785–1,551)	1,220 (871 -1 656)	783 (607–985)

Table 4 Retail market valuation: inputs and results.

PR Plausibility range.

1. Percent of daily cocaine users is the median of daily crack and daily powder cocaine users.

2. Daily cocaine amounts is based on crack cocaine, which is around a third less than suggested daily powder cocaine amounts. The crack cocaine daily amount was chosen due to limited participation of powder cocaine users in the research. Crack cocaine is widely sold as 'rocks'.

3. Based on an exchange rate of South African Rand (ZAR): 15.4: US$1.00 (8 November 2020).

DISCUSSION

This study was designed to assess the retail value of a criminalised and unregulated market. To the best of our knowledge the research is the first of its kind in South Africa. The study used practical methods to gather inputs to impute into a recommended drug market valuation formula (European Monitoring Centre for Drugs and Drug Addiction 2019). It was implemented with limited financial resources during the early part of the COVID-19 pandemic in South Africa. The study provides initial estimates which can be included in future studies towards an accurate estimation of the drug market value in the country.

The combined value of the cocaine, heroin and methamphetamine market calculated in this study is approximately $3.5 billion and represents an equivalent of about 1% of South Africa's GDP in 2020 (Statistics South Africa 2020). By comparison, sales of illicit alcohol in 2020 were reported to be $1.3 billion (Euromonitor Consulting 2021). The findings suggest that the nature and size of the drug market in South Africa are significant.

The International Narcotics Control Board notes that in 2020 there was limited data on drug trafficking in Africa, but it remains a major challenge on the continent (International Narcotics Control Board 2021). The ongoing trafficking of cocaine (mostly in West and North Africa) and heroin (in the Indian Ocean region) and increasing market size is acknowledged, along with small drug seizures reported in 2020 (International Narcotics Control Board 2021).

There is little data on the value of drug markets in other African contexts. The International Narcotics Control Board estimated that 2.5 tons of heroin was consumed in the East African local market in 2013 (about 10% of the volume estimated to be trafficked through the region), worth around $160 million (International Narcotics Control Board 2014). Superior data is available for Europe. The European Monitoring Centre for Drugs and Drug Addiction (EMCDDA) developed the valuation methodology that we applied to South Africa in this study. In 2017, the EMCDDA estimated the market value of the three drugs in the European Union at approximately $19.6 billion ($10.2 billion for cocaine; $1.1 for ATS and $8.3 for heroin) (European Monitoring Centre for Drugs and Drug Addiction 2019).

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Our estimates for South Africa have wide plausibility ranges. This is largely due to uncertainty around the population size estimates. The fieldwork identified widespread use of cocaine, heroin, and methamphetamine across the cities included in the study. Our best estimates for population size estimates for people who used drugs in 2020 was 3.5, 1.3, and 1.9 times greater than the 2017 household survey estimates for people who used heroin, cocaine, and methamphetamine in the three months prior to the household survey, respectively (Peltzer & Phaswana-Mafuya 2018). The 2017 household survey is likely to be subject to selection and reporting bias, and therefore an underestimate. The degree of underestimation of drug use in household surveys in South Africa is difficult to assess as people who use heroin, methamphetamine, and cocaine face arrest and are affected by intersectional stigmas that create barriers to disclosing drug use (Shelly et al. 2017).

Estimating population sizes is known to be challenging, and recommended practice is for the use of multiple empirical methods (Global HIV Strategic Information Working Group et al. 2017). Mapping with census and enumeration, capture-recapture, multiplier methods, and Wisdom of the Crowds are some of the recommended methods that can be integrated into biobehavioural surveys for people who use drugs (Global HIV Strategic Information Working Group et al. 2017). We used the key informant-driven mapping and enumeration approach (Ndayongeje et al. 2018) to describe illicit drug hotspots' geographic distribution and estimate the number of people who use drugs at the local level. The fieldwork was based on the premise that meaningfully involving people who use drugs through a participatory action research approach would reduce some potential bias of household surveys (Brown et al. 2019). Although limited in application, people who use drugs have generated bottom-up estimates in South Africa (Scheibe et al. 2017).

An increased number of studies has documented the spread and increased use of heroin in South Africa and the region since the early 2000s (Eligh 2020). The evidence base from research and programme data consistently shows upward trends in the prevalence of heroin use across the country. Increased cocaine use, particularly crack cocaine, has also been described. Between 1997 and 2006, increased cocaine use disorders among people accessing drug treatment centres were noted in the Eastern Cape, Gauteng, and Western Cape (Parry, Plüddemann & Myers 2007). Cocaine as a primary drug of use among drug treatment centres' clients peaked in 2008, followed by a slow decrease in cocaine-related treatment admissions (Dada et al. 2018). In the early 2000s the use of methamphetamine started to increase (Peltzer et al. 2009), initially in the Western Cape, and later in other provinces. Methamphetamine surpassed cocaine as a proportion of primary drug of use among people in drug treatment centres in 2010 (Dada et al. 2018). Methamphetamine-related admissions to drug treatment centres have continued to rise (Dada et al. 2018). The wide availability of methamphetamine was confirmed by our fieldwork. Data from sewage epidemiology in South Africa suggest notable underestimation of drug use. For example, the levels of methamphetamine metabolites in wastewater in Cape Town are among the highest levels documented, higher than cities in Europe and Malaysia (Archer et al. 2017; Eligh 2021).

Insights from a large number of people who currently use drugs elicited through focus groups and validation meetings give us confidence in the drug pricing estimates. The cost of drugs varied across cities and was generally lower than prices based on data from the police. For example, our study identified a median price of $10 per gram (mean of $11) for heroin in Cape Town, compared to a mean of $13 per gram from police pricing data (Eligh 2020). For methamphetamine, prices informed by police and other research calculated a mean price of $20 per gram (range $19–23) in November 2020 (Eligh 2021), compared to a median of $13 (range $5–13) in our study. The relative costs per gram of each drug is likely to reflect a combination of factors, including the quantities available for sale, user preferences, and drug quality. The findings of this study suggest that larger volumes of heroin are used compared to the other drugs included in this study in South Africa. The most recent data published by the United Nations Office on Drugs and Crime (2017) suggest that the typical purity of heroin and cocaine in South Africa is similar; 50% and 55%, respectively (United Nations Office on Drugs and Crime 2017).

LIMITATIONS

It is possible that we have over-estimated the number of people who use drugs and the proportion of people who use drugs daily. This may have resulted in over-valuation of the drug market. The Delphi method is largely informed by expert opinion and is less robust than a census or the use of Bayesian statistical methods, which adjust data in relation to prior estimates (Wesson, Mirzazadeh & McFarland 2018; WHO and UNAIDS 2016). However, in light of the improbability and cost of implementing a national census of people who use drugs and the limited available quantitative data we believe the use of the Delphi Method was justifiable. Furthermore, the use of the Delphi Method in our study was efficient and enabled virtual participation. It also built on fieldwork and other (limited) data and inputs from experts in a range of fields, including people who use drugs and harm reduction service providers.

This study did not measure perceived drug quality or drug purity. Drug quality and purity potentially influences drug cost in South Africa and may differ across the country and in relation to other countries (Eligh 2020). Heroin prices in southern African have been found to be largely influenced by availability, transport costs, and to a lesser degree, (perceived) quality (Eligh 2020).

The resources available for implementation limited the number of implementation sites. The inclusion of more fieldwork sites would have provided additional primary data and reduced the degree of extrapolation applied to districts where primary data was not collected. Additional implementation sites and primary data would have likely increased the accuracy of the estimates.

The fieldwork was designed to include people who are often missed or excluded from surveys, specifically people living on the street. Therefore, it is likely that more affluent people who use drugs were under-represented in data drawn from the fieldwork. Due to their higher income and the perceived relationship between quality and price, it is conceivable that the market value of this segment could be even higher than the total market size reported in this study. Potential under-representation of people who use drugs was taken into consideration in the Delphi process and was deemed to be of particular importance for powder cocaine. Participation of more affluent people in future drug market related research could be enhanced through the use of digital platforms to collect data, providing confidentiality is ensured. The participation of drug sellers could also provide additional insights into other segments of the population of people who use drugs.

The concurrent COVID pandemic and associated lockdowns and restrictions affected study implementation. The local and national consensus workshops were conducted virtually. This created difficulties for a number of people who use drugs, as it required internet access, which was often not available to them. Attempts were made to include representatives from the SANPUD network to overcome these challenges through linking with local organisations or providing data where possible.

CONCLUSION

Our study is the first of its kind in South Africa. It adds to the understanding of the drug economy by quantifying the market volumes and values for cocaine, heroin, and methamphetamine using data collected by and from people who use drugs.

Despite the inherent limitations of the study, the results suggest that a large drug market exists in South Africa. Considering the size of the market and the substantial revenue generated, further consideration should be given to stakeholders in the value chain.

Apart from the value and volume of the market, our research provides valuable insights into the way drug markets can be researched. People who use drugs are closest to the market, have valuable insights, and are arguably best positioned to identify potential sources of data and interpret its value, relevance, and validity in situ. Thus, people who use drugs have skills, capacity, and expertise that should be included in research teams investigating drug markets.

Drug markets are complex and multi-faceted. Therefore, researchers should work across fields and disciplines to develop a more comprehensive understanding of the drug market and its role and impact on communities and the national economy. Importantly, studies related to the drug market should include people who use drugs in the design and implementation of the research.

Subsequent studies with more accurate input estimates, particularly around population sizes, will improve the precision of the market value estimates. This could be done through conducting more city-level population size estimations (increasing rigor and geographical coverage) along with research that uses emergent data to refine national estimates. Future studies that measure drug purity would provide insights into comparative drug pricing and market valuation. Additional research into the flow of money in the market and how the trade in illicit drugs impacts individuals and communities would be important to inform policy and action.

ADDITIONAL FILE

The additional file for this article can be found as follows:

- **Supplementary Tables.** Supplementary Tables s1 and s2. DOI: https://doi.org/10.31389/jied.156.s1

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COMPETING INTERESTS

The authors have no competing interests to declare.

AUTHOR CONTRIBUTIONS

AS developed the protocol and tools and led data analysis and developed the first draft of the manuscript. MJS led the implementation of the fieldwork and supported data analysis and drafting the manuscript. SS co-developed the protocol and supported implementation, analysis, and manuscript development. All authors reviewed and approved the final version of the manuscript.

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