BMJ Open

Cross-sectional study of the health of southern African truck drivers

Samanta Tresha Lalla-Edward ,[1] Alex Emilio Fischer ,[1] W D Francois Venter,[1] Karine Scheuermaier,[2] Ruchika Meel,[3] Catherine Hankins,[4,5] Gabriela Gomez,[6] Kerstin Klipstein-Grobusch,[7,8] Melvin Draaijer,[9] Alinda G Vos[1,7,10]

To cite: Lalla-Edward ST, Fischer AE, Venter WDF, *et al*. Cross-sectional study of the health of southern African truck drivers. *BMJ Open* 2019;**9**:e032025. doi:10.1136/bmjopen-2019-032025

► Prepublication history for this paper is available online. To view these files, please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2019-032025).

Received 30 May 2019
Revised 29 August 2019
Accepted 25 September 2019

For numbered affiliations see end of article.

Correspondence to
Mr Alex Emilio Fischer;
afischer@wrhi.ac.za

ABSTRACT

Objectives Lifestyle and working conditions of truck drivers predisposes them to risk-factors associated with communicable and non-communicable diseases, but little is known about the health status of African truck driver. This study aims to assess a cross-section of truckers in South Africa to describe their health information.

Setting The study took place across three truck-stop rest areas in the South African provinces of Free State and Gauteng.

Participants Eligibility criteria included being males aged 18 years and older, full-time employment as a long-distance truck driver. A total of 614 male truck drivers participated; 384 (63%) were Zimbabwean and 325 (55%) completed high-school.

Primary and secondary outcome measures The trucker survey explored demographics; working conditions; sexual, eating and sleeping behaviours; mental health status, medical history and cardiac risk-factors. Medical assessments included physical measurements, glucose and lipid measurements, ECG, carotid intima-media thickness (CIMT) and cardiac ultrasound.

Results In the previous month, 554 (91%) participants were sexually active; 522 (86%) had sex with a regular partner; 174 (27%) with a casual partner; 87 (14%) with a sex worker. Average time driving was 10 hours/day, 20 days/month, 302 (50%) never worked night shifts and 74 (12%) worked nights approximately four times per week. 112 (18%) experienced daytime sleepiness and 59 (10%) were ever hospitalised from an accident. Forty-seven (8%, 95% CI 5.3 to 9.5) were HIV-positive, with half taking antiretrovirals. Forty-eight (8%) truckers had some moderate depression, while 21 (4%) suffered from post-traumatic stress disorder. Reported tuberculosis, myocardial infarction, and diabetes were <3%. Prominent cardiac risk-factors included smoking (n=63, 11%), consuming alcohol (>15 drinks/week) (n=54, 9%), overweight/obesity (n=417, 69%), and hypertension (n=220, 36%,95% CI 32.1 to 39.7). ECG results showed 23 (4.9%) and 29 (5.3%) drivers had left ventricular hypertrophy using the Cornell criterion and product, respectively. CIMT measurements indicated nine (4.2%) drivers had a carotid atherosclerotic plaque.

Conclusion This first holistic assessment of health among southern African male truck drivers demonstrates substantial addressable cardiovascular risk factors, mental health issues and sexual risk behaviours.

Strengths and limitations of this study

- This study is possibly the largest and most comprehensive truck driver health and wellness survey completed in sub-Saharan Africa.
- Previous studies have been conducted in silos, while this study explores how multiple risk factors interact with common health conditions.
- The comprehensiveness of the survey presented some limitations, due to convenience sampling (no tracked refusal rates), self-reporting, and the length of time required by participants.
- Additional limitations included challenges in recruiting South African truck drivers because long-distance driving is mainly performed by foreign drivers and inability to access healthcare programme and information directly from the trucking companies since this is strictly regulated and controlled by unions.
- This study did not include any tabulations, modelling or regressions; it has established a comprehensive baseline of health problems and associated risk-factors for truck drivers in South Africa in order to lead research for future interventions.

INTRODUCTION

Land transport is a $3 billion industry in South Africa that employs over 70 000 commercial truck drivers,[1 2] and due to operational demands, these long-distance truck drivers may be susceptible to a variety of adverse health outcomes. The extended time away, including long driving hours and night shifts, may make them vulnerable to risk-factors for communicable diseases, such as sexually transmitted infections (STIs),[3 4] non-communicable diseases (NCDs) and mental health disorders.[5]

Driving long hours disrupts healthy sleep cycles and encourages drivers to lead a sedentary lifestyle. The risk of diabetes, hypertension and heart disease is exacerbated by job-related stress, sleep disruption, nightshift-related circadian misalignment and limited access to healthy food at rest stops.[6–8] The travelling lifestyle may also

provide limited access to healthcare facilities, especially for long-distance drivers from outside of South Africa, who easily and frequently cross borders. While traditional public health facilities are available to truck drivers across the country, truck drivers hardly access these services as they cannot take leave or clinics are not reachable by large trucks. In order to reduce barriers to access, mobile HIV clinics and roadside wellness clinics have been established to accommodate all drivers at no cost.[9 10] The North-Star Alliance (NSA) clinics, for example, use trained clinical and outreach teams to provide primary healthcare services, HIV prevention and screening for other infectious diseases in converted shipping containers.

These initiatives have shown successes with the general uptake of healthcare, including HIV counselling and testing (HCT) for truckers,[10 11] however, most of the focus is on preventing communicable diseases and very little is known about long-term health trends within this group. Current findings have come from studies and interventions that examine individual factors or conditions, but they do not incorporate a comprehensive health approach that includes NCDs.[12 13] The objective of this study is to use the Trucker Health Survey, which was developed to take a comprehensive snapshot of disease prevalence in truck drivers at selected South African locations, in order to determine what the common health problems are for truck drivers in South Africa. This body of evidence should establish a baseline to lead researchers towards future interventions.

METHODS

Study design and setting

The Trucker Health Survey is an initiative of the Wits Reproductive Health and HIV Institute and NSA, a non-governmental organisation located along the main sub-Saharan trucking corridors that provides truck drivers, sex workers and local communities with primary healthcare services. These services include general health check-ups, STI and malaria testing and treatment, HCT and tuberculosis (TB) screening.[12]

Enrolment in this cross-sectional study took place between October 2016 and March 2017. Recruitment was done at truck stops in two provinces; one truck stop at the Shell garage at the N1 highway close to Bloemfontein (Free State), multiple truck stops in Pomona, Johannesburg (Gauteng) and one truck stop in Soweto (Gauteng). NSA already had a strong presence due to their current clinical infrastructure in Bloemfontein and Pomona. Some truck stops in Pomona were privately owned but did not belong to a transport company. They accommodated mainly foreign long-distance drivers as South-African drivers would stop at the premises of their company in South Africa. To reach South-African drivers the truck stop in Soweto, Johannesburg, was added from January to March 2017. As this was a harder group of people to recruit, we employed various methods of invitation to participate. These included handing out invitation cards individually and to groups at truck stops, placing them on truck windscreens where no driver was available and recruiting at companies. In some instances, the recruiter would be addressing one or two people and a group would form. These methods did not facilitate us accurately noting the number of invitations extended and as such no invitation log was maintained.

Eligibility criteria included: males aged 18 years and older, full-time employment as a long-distance truck driver and able to provide informed consent for study procedures.

Patient and public involvement

Patients and the public were not involved in the study design, or in the recruitment to, and conduct of the study.

Data collection

The invitation card contained details for where and when drivers could go to the study clinic (participating NSA wellness clinic) for study enrolment. Dependent on when a truck driver decided to enrol, he could go to the study clinic immediately on invitation or any time within the study period. Data collection was completed during a single visit that commenced with HIV testing and demographic data collection, followed by mental health and NCD risk-factor questionnaires. Participants underwent a physical examination, with functional and laboratory testing.

HIV testing

A trained nurse/counsellor conducted HIV pretest counselling, followed by rapid testing with tests supplied by the National Department of Health (NDOH). Testing was performed on whole-blood from a finger prick, using two rapid assays, according to the NDOH HCT Policy.[14] If found HIV-positive, additional blood was collected for measurement of CD4+ cell count, with participants then referred to local public clinics for the accepted standard of care.[14]

Questionnaire data

For demographic and health information, an interview and multiple externally validated questionnaires were administered. Due to the use of externally validated questionnaires, no pilot testing was undertaken with the study population before data collection. Mental and social health issues were explored with the following questionnaires (or relevant parts thereof): eating behaviour,[15] health service use,[16] HIV testing questionnaire,[17] safe sex and behaviour,[18] International Index of Erectile Function-5 (IIEF-5) questionnaire for erectile dysfunction (ED),[19] NEO questionnaire,[20] traumatic events questionnaire, post-traumatic stress disorder (PTSD) checklist (PCL-5) questionnaire[21] and PHQ-9 (for depression).[22] We also evaluated daytime sleepiness using the Epworth Sleepiness Scale (ESS),[23] which was validated in a population of South Africans using English as a second language, similar to our truckers' population.[24]Overall, scores of 10 and less were considered as normal daytime

sleepiness while 11 and more were considered as excessive daytime sleepiness. In addition, for our analysis, we further divided three categories of excessive daytime sleepiness, with scores of 11–12, 13–15 and greater than 16, corresponding to mild excessive, moderate excessive and severe excessive daytime sleepiness, respectively.

For respiratory health, the British Medical Research Council Respiratory questionnaire,[25] the World Health Survey,[26] the ATS-DLD-78-A survey[27] and industry-standard questions from other publications[28] were used. Cardiovascular health was explored with a modified version of the WHO STEPs instrument[29] while a survey for musculoskeletal injuries was also administered.[30]

Physical examination

Trained nurses took measurements of height, weight, waist and hip circumference and blood pressure. Blood pressure was measured at both arms, with a third measurement taken on the arm with the highest value. Waist circumference was measured halfway between the lower rib and the iliac crest during expiration in standing position. Non-fasting blood was collected from participants for the measurement of C reactive protein (CRP), creatinine, alkaline phosphatase, random glucose, total cholesterol, high-density lipoprotein (HDL) cholesterol, triglycerides and hepatitis B antigen. Low-density lipoprotein (LDL) cholesterol was calculated using the Friedewald formula. Urine was collected for measurement of protein. Extra blood and urine samples were stored for future research.

A standard 12 lead ECG was taken using a computer-based ECG device (SE-1515 DP12, EDAN),[31 32] and left ventricular hypertrophy (LVH) assessed using the Cornell's criterion, Cornell's product and the Solokow-Lyon's criterion.[33 34]

Carotid intima-media thickness (CIMT) was measured in 217 (42.9%) participants, dependent on the sonographer's availability, after a 15-min rest. A Siemens Acuson p500 ultrasound (Siemens Healthcare (Pty) Ltd, South Africa) with a ≥7 mHz linear probe was used. Measurements of common carotid artery walls were taken and analysed with the semi-automatically Artery Measurement System software (Chalmers University, Götenburg, Sweden) based on the standard procedures described by Bolus in 2016 and Naqvi in 2014.[35 36]

Transthoracic echocardiography was performed on 132 (21%) participants, dependent on the sonographer's availability, using a transducer on Siemens Acuson p500 ultrasound. Images were obtained according to a standardised protocol according to the 2015 American Society of Echocardiography chamber quantification guidelines.[37 38]

Statistical analysis

In line with the aim of this paper data are descriptive only and reported as mean with SD, median with IQR or count and percentages as appropriate. Internal consistency among items of the PHQ-9, PCL-5 and ESS questionnaires was verified with Cronbach's alpha tests. A score of >0.7–0.8 was considered acceptable, >0.8–0.9 good and any score >0.9 as excellent reliability.

RESULTS

Study population

Of 614 truck drivers responding to the survey most (96%) were black Africans. The median age of respondents was 37 years old (IQR: 31–42 years), and the majority (80%) were married. The majority of participants (63%) were Zimbabwean nationals, while 20% were South Africans and 7% reported Zambian nationality. Almost all respondents (99%) completed primary school, while more than half (55%) completed high school and further 9% completed tertiary education (table 1).

Occupational characteristics are presented in table 1. On average, truck drivers in this study reported 9 years of driving experience (IQR: 5–14 years), and spent an average of 10 hours per day on the road. The median days spent driving per month was 20 (IQR: 15–24 days). On average, drivers spent 4 days per month waiting for loading/offloading of their truck, had 3 days off a month and an additional 22 leave days per year.

When participants were asked to indicate how often they worked nights (at least 3 hours between 22:00 and 06:00), 302 (50%) stated that they never worked night shifts, while 74 (12%) reported that they worked nights at least four times a week. Sixty-five (10.6%) participants had worked in the mining industry for at least 1 year, 44 (7.3%) participants had worked in environments that exposed them to dust and another 17 (2.8%) had worked in jobs that exposed them to dangerous fumes. One hundred and fifteen (19%) truck drivers had reportedly been involved in an accident, with half of them (51%) hospitalised due to the accident.

Mental and social health characteristics

Health services

When truckers were asked to indicate the health facilities and services that they had utilised in the past 6 months, NSA health services were the most cited (n=278, 46%), followed by community health centres, and clinics (n=270, 44%). Some participants also utilised pharmacies and hospital-based clinics, however no one mentioned the use of mental health services. All information pertaining to mental and social health is presented in table 2.

Sexual activity and behaviour

Only four truckers (0.2%) reported that their sexual partners were men. Vaginal intercourse (n=607, 99%) was the most frequent type of sexual intercourse. Truck drivers had varying levels of recent sexual activity, with 554 (91%) reported having sex in the past month, and a median coital frequency of three times a month. 522 (86%) truckers stated that they had sex with a regular partner, while 174 (27%) stated that sex was with a casual partner, and 87 (14%) participants reported recent sexual activity

Table 1 Sociodemographic and occupational characteristics

Characteristic	Median	IQR
Age in years (n=614)	37	31–42
Truck driving years (n=612)	9	5–14
Hours spent driving per day (n=611)	10	8–12
Days spent driving per month (n=614)	20	15–24
Days waiting per month (n=609)	4	2–7
Off days per month (n=610)	3	0–6
Leave days per annum (n=603)	22	13–30
Sociodemographic characteristic	**Frequency**	**Percentage***
Country (n=612)		
South Africa	123	20.1
Zimbabwe	384	62.6
Zambia	45	7.4
Other	60	9.8
Race (n=608)		
Black African	587	95.6
Coloured	8	1.3
Indian	6	1.0
White	5	0.8
Other/declined	2	0.3
Highest level of education (n=591)		
No formal education	2	0.3
Less than primary	3	0.5
Primary completed	46	7.8
High school completed	325	55.0
Matric completed	161	27.2
College complete	54	9.1
Marital status (n=607)		
Married	488	80.4
Living together	22	3.6
Never married	19	3.1
Divorced	18	3.0
Widower	9	1.5
Other	51	8.4
Occupational characteristic	**Frequency**	**Percentage***
Truck driving years (n=603)		
1–5 years	205	34.0
6–10 years	172	28.5
11–15 years	123	20.4
>15 years	103	17.1
Night shifts (n=607)		
Never	305	50.3
Once per week	93	15.3
2–3 times per week	135	22.2
4–5 times per week	58	9.6
More than five times per week	16	2.6
Occupational exposures (n=608)		
Worked in mining at least 1 year	65	10.6
Worked in dusty job at least 1 year	44	7.3
Exposed to gas or chemical fumes	17	2.8
No work exposures	482	79.3
Vehicle accidents (n=605)		
Never involved in accident	490	81
Involved in accident	115	19
Hospitalised from accident (n=115)	59	51

*Percentages may not add up to 100% as some subcharacteristics were not mutually exclusive.
n, number.

was with a sex worker. Reported condom usage for regular partners, casual partners, and sex workers, was 15%, 57% and 83%, respectively.

When asked about the number of regular partners in the past year, 453 (75%) truckers indicated that they only had one regular partner, while 130 (21%) had more than one, and 25 (4%) reported not having a regular partner. Among the 595 who responded about ED, 313 (53%) had no ED, while only 11 (1.9%) people had moderate-severe ED.

Mental health and sleep wellness

Depression was screened with PHQ-9 and the Cronbach's alpha value was 0.76. The questionnaire showed that 48 (8.1%) participants had moderate depression, while none one of the respondents reported severe depression. The PCL-5 tool; however, identified PTSD in 21 (3.6%) truck drivers, with a Cronbach's alpha of 0.92. Daytime sleepiness was assessed using the ESS and the Cronbach's alpha score was 0.77. Overall, 77 (12.7%) stated that they experienced moderate to severe excessive daytime sleepiness.

HIV status and antiretroviral treatment

Information on their HIV status was provided by 581 truck drivers (17 respondents did not provide data, and another 16 reported their status as unknown). Of those, 47 (8%) reported that they were HIV-positive, and 23 (49%) of those HIV-positive participants were on antiretroviral treatment (ART) (table 3). The majority of truckers (97%) agreed to an HIV test. HIV prevalence

Table 2 Mental and social health characteristics

Mental and social health characteristic	Frequency	Percentage*
Health services (n=614)		
North-Star Alliance	278	45.3
Community health centres/clinics	270	44.0
Pharmacies	84	13.7
Hospital-based clinics	51	8.3
Mental health services	0	0
Other	26	4.2
Sexual activity (n=609)		
Regular partner	522	85.7
Casual partner	147	24.1
Sex worker	74	12.2
Overall	554	91.0
Condom use		
Regular partner (n=513)	77	15.0
Casual partner (n=136)	78	57.4
Sex worker (n=74)	61	82.4
Regular partners in the last year (n=614)		
One regular partner	453	73.8
Multiple regular partners	130	21.2
No regular partners	25	4.1
Depression (n=597)		
Minimal	399	66.8
Mild	150	25.1
Moderate	40	6.7
Moderately severe	8	1.4
Severe	0	0
Post-traumatic stress disorder (PTSD) (n=583)		
Suffering PTSD	21	3.6
No PTSD	562	96.4
Intimate partner violence (IPV) (n=611)		
Limited/no IPV last year	569	93.1
Broad IPV last year	42	6.9
Limited/no IPV lifetime	509	83.3
Broad IPV lifetime	102	16.7
Daytime sleepiness (n=608)		
Normal	496	81.6
Mild excessive	35	5.8
Moderate excessive	46	7.6
Severe excessive	31	5.1
Erectile dysfunction (n=595)		
None	313	52.6
Mild	206	34.6
Mild-moderate	65	10.9
Moderate-severe	11	1.9
HIV status: self-reported (n=518)		
HIV negative	471	90.9
HIV-positive	47	9.1
HIV-positive and taking ART (n=47)	23	48.9
HIV-positive not on ART (n=47)	24	51.6

*Percentages may not add up to 100% as some subcharacteristics were not mutually exclusive.
ART, antiretroviral therapy; n, number.

among 597 tested drivers was 7.1% (n=42; 95% CI 5.3% to 9.5%). The validity of self-reported HIV status was assessed comparing self-report and rapid test. Seven drivers who reported to be HIV-negative, were rapid test positive. Three drivers who reported to be HIV-positive, had negative rapid test results. Most drivers appeared to be aware of their status, with sensitivity and specificity of self-reporting being 83% (95% CI 67.9% to 92.8%) and 99.8% (95% CI 98.3% to 99.9%), respectively.

Chronic diseases history

Respiratory

TB infection was screened for in all participants with the NDOH TB screening tool, and 17 (2.8%) truckers had previously acquired TB. General breathing difficulty was assessed and 49 (13%) reported some shortness of breath, 18 (2.9%) drivers described persistent coughing, 7 (1.2%) had previously undergone a chest operation and 3 (0.5%) had experienced wheezing. All information pertaining to chronic disease history is presented in table 3.

Musculoskeletal injuries

A total of 51 (25%) truckers had work-related pain that lasted at least 2 days in the last year, while 63 (10%) had work-related pain that lasted more than 3 months. The most common work-related injuries were lower-back and upper-back pain, experienced by 92 (15%) and 74 (12%) truckers, respectively. Of the participants that experienced work-related pain, 45 (31%) stated that the pain interfered with their work, and 5 (3%) had to take time off work.

Cardiovascular disease and risk-factors

Self-reported cardiovascular outcomes identified that eight (1.3%) participants had a heart attack or stroke, while three (0.5%) reported angina. Only 290 (47%) truckers had ever undergone blood pressure testing and 32 (11%) had hypertension. Of these 32 drivers, 10 (30%) were currently on physician-prescribed medication for hypertension, while two (6.3%) were taking traditional

Table 3 Chronic disease history

Respiratory and cardiac history	Frequency	Percentage*
TB (n=607)		
History of TB	17	2.8
Cough of >2 weeks	7	1.2
Fever >2 weeks	5	0.8
Dyspnoea (n=363)		
No regular trouble breathing	314	86.5
SOB walking up a slight hill or hurrying	44	12.1
Walks slow with frequent stops	2	0.6
Stops every 100 m to catch breath	1	0.3
Too breathless to leave house/undress	2	0.6
Other respiratory outcomes (n=583)		
Cough several times per day	18	2.9
Chest operation	7	1.2
Wheezing	3	0.5
Heart disease: self-reported (n=614)		
Heart attack or stroke	8	1.3
Angina	3	0.5
No previous heart disease	603	98.2
Hypertension (HTN): self-reported (n=612)		
Ever tested for HTN	290	47.4
HTN diagnosed by a doctor (n=290)	32	11.1
Take HTN meds from doctor(n=32)	10	30.3
Take traditional heeler remedy (n=12)	2	6.3
Diabetes: self-reported (n=612)		
Blood sugar tested by doctor	121	19.7
Diabetes diagnosed by doctor (n=121)	12	9.9
Take oral meds from doctor (n=12)	3	25.0
Take insulin prescribed by doctor (n=12)	3	25.0
Take traditional heeler remedy (n=12)	1	9.1
Cholesterol: self-reported (n=612)		
Cholesterol tested by doctor	20	3.3
High cholesterol diagnosis (n=20)	3	15.0
Take meds prescribed by doctor (n=20)	0	0.0
Take traditional heeler remedy (n=20)	0	0.0
Family history (n=588)		
Parents chronic lung condition	21	3.6
Parents heart attack before 60 years	20	3.4
Parents stroke before 60 years	18	3.1
Smoking (n=606)		
Tobacco- ever smoked	90	14.7
Tobacco: current smoker	63	11.1
Marijuana: ever smoked	28	4.8
Marijuana: current smoker	23	3.9
Domestic smoke exposure (n=606)		
Secondhand smoke as child	121	20.0
Fireplace in house	160	26.4
Alcohol consumption (n=600)		
Ever used alcohol	240	39.8
Current alcohol use	196	32.5
Criticised for drinking (n=240)	53	21.9
Drinks daily (n=196)	19	9.7
Alcohol volume consumed last week (n=196)		
Did not drink	20	10.2
Moderate drinkers (1–14drinks)	122	62.2
Problem drinkers (15–21drinks)	27	13.8
Heavy drinkers (>21 drinks)	27	13.8
Physical activity at least two times a week (n=614)		
Mild	78	12.7
Moderate	125	20.3
Strenuous	254	41.3
Diet and nutrition (n=608)		
Soft drinks at least two times a day	474	78.0
Snacks at least 1 a day	432	71.1
Fruit at least two times a day	347	57.1
Vegetables at least two times a day	280	46.1
Musculoskeletal pain (n=614)		
Overall pain >2 days	151	24.6

Continued

Table 3 Continued

Respiratory and cardiac history	Frequency	Percentage*
Overall pain >3 months	63	9.8
Lower-back pain >2 days	92	15.0
Lower-back pain >3 months	37	6.0
Upper-back pain >2 days	74	12.1
Upper-back pain >3 months	31	5.0

*Percentages may not add up to 100% as some subcharacteristics were not mutually exclusive.
n, number; SOB, shortness of breath;TB, tuberculosis.

remedies. One hundred and twenty-one (19.7%) participants previously had their blood-sugar checked, and 12 (10%) had elevated blood-sugar. Of those, 3 (25%) were taking insulin, another three (25%) were taking oral medication, and one (9.1%) was on traditional remedies for diabetes. For cholesterol, only 20 participants (3.3%) previously had their levels checked and of these, three (15%) were diagnosed with raised cholesterol, but no one was taking medication (doctor-prescribed or traditional) for management.

For domestic smoke exposure, 121 (20%) had been exposed to secondhand smoke during childhood, and 160 (26%) had indoor fireplace exposure. Ninety (15%) drivers had ever smoked tobacco and 63 (11%) still smoked. Marijuana use was much lower, as only 28 (5%) had ever smoked it, and 23 (4%) identified as current smokers. The majority of participants who currently smoked reported that they smoke daily (76% for tobacco, 68% for marijuana). For alcohol use, 240 (40%) truck drivers had ever consumed alcohol and 196 (33%) still drank regularly. Of the drivers who drank, 54 (28%) were problem or heavy drinkers (>15 drinks per week), comprising 9% of the total population. One trucker reported using acid, but no other recreational drugs were disclosed by participants.

Study participants were asked to indicate how often they engaged in mild, moderate or strenuous exercise, and only 254 (41.3%) exercised strenuously at least two times a week. Mild and moderate exercise two times a week was even less with engagement levels of 78 (12.7%) and 125 (20.3%), respectively.

When asked about their diet, 347 (57%) had at least two fruits daily, while only 280 (46%) had two servings of vegetables. Snacks were much higher, as 474 (78%) drank at least two soft drinks daily, and 347 (71%) had at least one snack.

Regarding family history, 20 (3.4%) truckers reported a parent who had suffered a heart attack before the age of 60, while 18 (3.1%) had a parent experiencing a stroke before the age of 60.

Clinical characteristics

The median height and weight was 1.71 m (IQR: 1.65–1.76 m) and 79 kg (IQR: 69–90 kg), respectively. Median waist and hip circumference were 87 cm (IQR: 77–99 cm) and 101 cm (IQR: 94–108 cm), respectively. Calculated body mass index (BMI) revealed that 417 (69%) of all respondents were either overweight (BMI 25–29.9 kg/m^2) or obese (BMI >30 kg/m^2).[39] All information pertaining to clinical characteristics is presented in table 4.

Blood pressures were taken for every truck driver, and the mean measurements were 131 mm Hg (IQR: 122–140 mm Hg) systolic and 83 mm Hg (IQR: 76–89 mm Hg) diastolic. Based on the South African hypertension practice guide that defined hypertension as systolic >140 mm Hg or diastolic >90 mm Hg,[40] 35.8% (95% CI 32.1 to 39.7) were hypertensive.

The median blood-glucose level was 5.2 mmol/L (IQR 4.6–6.3 mmol/L) and 15 (2.6%) participants were considered to be diabetic with a non-fasting glucose above 11.0 mmol/L. The average cholesterol level was within normal ranges, as were serum creatinine and triglyceride levels, while median serum CRP levels were 1.2 mg/L.

Table 5 presents the cardiovascular measurements and ECG results showed that 23 (4.9%) and 29 (5.3%) drivers, respectively, had LVH using the Cornell criterium and product. According to the Solokow-Lyon criterium 136 (23.8%) participants had LVH. CIMT measurements showed that nine (4.2%) drivers had a carotid atherosclerotic plaque. Echocardiographic outcomes showed that 10 drivers (7.6%) had a left ventricular mass above 115 g/m^2, which is an indicator of LVH. The median ejection fraction (EF) was 59% (IQR 55–65). No driver had an EF <50% which is a sign of heart failure. No moderate or severe valve pathology was observed.

DISCUSSION

With over 600 participants, this study is possibly the largest and most comprehensive truck driver health and wellness investigation in sub-Saharan Africa, and the methods used have established a comprehensive reference point of health problems and associated risk factors present in this group. Almost all participants were black African males, the majority from Zimbabwe and over half of the participants had completed high school. Most participants were sexually active with a regular partner, while one quarter had a causal partner and 14% reported sexual activity with a sex worker. Participants drove an average of 10 hours per day, 20 days per month, and half had never worked night shifts, while 12% reported that they worked nights at least four times a week. Daytime sleepiness was experienced by almost 20% of participants, while moderate depression and PTSD were experienced by less than 10% of all participants. One-in-five drivers had been in an accident, and half of these drivers had been

Table 4 Physical testing

Physical measurements	Median	IQR
Systolic blood pressure (n=614)	131 mm Hg	122–140 mm Hg
Diastolic blood pressure (n=614)	83 mm Hg	76–89 mm Hg
Heart rate (n=614)	75 bpm	66–83 bpm
Height (n=614)	1.71 m	1.66–1.76 m
Weight (n=614)	79 kg	69–90 kg
Neck circumference (n=614)	37 cm	36–40 cm
Waist circumference (n=614)	87 cm	77–96 cm
Hip circumference (n=614)	101 cm	94–108 cm
Laboratory assessments	**Median**	**IQR**
Serum C reactive protein (n=584)	1.2 mg/L	0.5–2.7 mg/L
Protein urine quantitative (n=16)	0.44 mmol/L	0.22–0.62 mmol/L
Blood-glucose (n=583)	5.2 mmol/L	4.6–6.3 mmol/L
Serum creatinine (n=585)	91 mmol/L	81–104 mmol/L
Serum cholesterol (n=585)	4.39 mmol/L	3.9–5.13 mmol/L
Serum LDL Cholesterol (n=585)	2.7 mmol/L	2.24–3.35 mmol/L
Serum HDL cholesterol (n=585)	1.2 mmol/L	1.02–1.45 mmol/L
Triglyceride (n=585)	1.33 mmol/L	0.92–2.05 mmol/L
Physical characteristic	**Frequency**	**Percentage***
Blood pressure-tested (n=614)		
Normotensive (sys: <140; dias: <90)	394	64.2
Grade 1 (sys: 140–159; dias: 90–99)	151	24.6
Grade 2 (sys: 160–179; dias: 100–109)	43	7.0
Grade 3 (sys: >180; dias: >110)	26	4.2
Total HTN (sys: >140; dias: >90)	220	35.8
Blood sugar-tested (n=604)		
<4.5 mmol/L	121	20.7
4.5–7.8 mmol/L	414	71.0
7.9–11.1 mmol/L	34	5.8
>11.1 mmol/L	15	2.6
Body mass index (BMI) (n=604)		
Underweight (BMI <18.5)	7	1.2
Normal weight (BMI 18.5–24.9)	180	29.8
Overweight (BMI 25–29.9)	244	40.4
Obese (BMI >30)	173	28.6
Hepatitis B (n=586)		
Positive	29	5.0
Negative	557	95.0

*Percentages may not add up to 100% as some subcharacteristics were not mutually exclusive.
dias, diastolic;n, number; sys, systolic.

hospitalised due to the accident. Reported histories of TB, myocardial infarction and diabetes were below 3%, however, prominent cardiac risk-factors included smoking (11%), consuming alcohol (>15 drinks/week) (9%), overweight/obesity (69%) and hypertension (36%). The frequency of hypertension and diabetes is in line with nationwide data from South Africa[41] but the frequency of overweight/obesity is double of what is seen in the general population (69% vs 31%).[42] Reported HIV prevalence was less than the national average (13.1%),[43] at 8%, and less than half were taking ART.

Table 5 Cardiovascular measurements

Electrocardiography: heart	Median	IQR
Left ventricle		
LVED index, mm/m^2 (n=132)	24.32	22.53–26.11
LVESD index, mm/m^2 (n=132)	16.01	14.41–17.74
IVS index, mm/m^2 (n=132)	5.15	4.60–5.89
LVPW index, mm/m^2 (n=132)	4.81	4.26–5.40
LV EDV index, mL/m^2 (n=128)	51.45	42.26–57.54
LV ESV index, mL/m^2 (n=129)	19.72	16.36–24.17
LVM index g/m^2 (n=132)	79.70	68.34–94.88
Left atrium		
LA, mm/m^2 (n=132)	17.40	16.13–19.36
LA, volume mL/m^2 (n=132)	17.09	12.85–20.30
Systolic and diastolic function		
Simpsons EF, % (n=130)	59	55–65
Mitral inflow E/A ratio (n=130)	1.35	1.15–1.59
Mitral flow deceleration, ms (n=131)	172	150–200
Right ventricle echocardiography		
RV base index, mm/m^2 (n=132)	19.21	17.33–21.51
TAPSE, mm (n=124)	19	17–22
Carotid intima-media thickness		
Mean-mean CCA-IMT, mm (n=217)	0.529	0.493–0.596
Mean-max CCA-IMT, mm (n=217)	0.608	0.554–0.685
Max bulb IMT, mm (n=216)	0.668	0.570–0.830

Electrocardiography: heart	Frequency	Percentage*
Pulmonary valve (n=131)		
Normal	96	73.3
Mild PR	35	26.7
Tricuspid valve (n=132)		
Normal	93	70.5
Mild TR	39	29.5
Aortic valve (n=132)		
Normal	131	99.2
Mild AR	1	0.8
Mitral valve (n=132)		
Normal	108	81.8
Mild MR	24	18.2
LVH echo (n=132)		
<115 g/m^2	122	92.4
≥115 g/m^2	10	7.6
Cornell criterium (n=555)		
<2.8 mV	532	95.6
≥2.8 mV	23	4.1
Cornell product mV (n=547)		
<244 mVms	518	94.7
≥244 mVms	29	5.3
Sokolow-Lyon criterium (n=581)		
<3.5 mV	395	68.0
≥3.5 mV	186	32.0
Carotid intima-media thickness		
Plaque (CCA-IMT >1.0 mm) (n=216)	9	4.2
QTC interval (n=484)		
<450 ms	470	97.1
450–500 ms	14	2.9
>500 ms	0	0.0

*Percentages may not add up to 100% as some subcharacteristics were not mutually exclusive.
AR, aortic valve regurgitation; CCA-IMT, common carotid artery intima-media thickness; E/A, early diastole/atrial contraction; EDV, end-diastolic volume; EF, ejection fraction; ESV, end-systolic volume; IMT, intima-media thickness; IVS, interventricular septal thickness in end diastole; LA, left atrium; LV, left ventricle; LVED, left ventricular end-diastolic diameter; LVESD, left ventricular end-systolic diameter;LVH, left ventricular hypertrophy; LVM, left ventricular mass; LVPW, left ventricular posterior wall thickness in end diastole;MR, mitral valve regurgitation; n, number; PR, pulmonary valve regurgitation; RV, right ventricle; TAPSE, tricuspid annular plane excursion; TR, tricuspid valve regurgitation.

The methods described here are not only feasible to execute, but their findings provide valuable information regarding the comprehensive health and wellness of truck drivers in South Africa. By examining the findings, relatively low condom use and ART coverage indicate that HCT is still a priority in this population. Elevated risk-factors for NCDs and mental health suggest that screening and linkage to care for these areas need to be prioritised. Surprisingly, although nearly 50% of truck drivers reported doing night shifts at least once a week, only 18% had symptoms of excessive daytime sleepiness. While these findings have highlighted priority areas for truckers in South Africa, these methods could be replicated in similar populations to describe their baseline health statistics and identify areas of need.

Limitations include challenges in recruiting South African truck drivers because long-distance driving is mainly performed by foreign drivers. Accessing healthcare programme and information directly from the trucking companies was difficult, as this is strictly regulated and controlled by unions. The comprehensiveness of the survey also presented a limitation, as some drivers

could not join because it would take too much time (it couldn't be performed over a lunch break, for example). A sampling bias may also be present, as the HIV prevalence in the survey is lower than that of the general population, suggesting that truck drivers with risky behaviours may be failing to test for HIV.

Author affiliations
[1]Ezintsha, a sub-division of Wits Reproductive Health and HIV Institute, University of the Witwatersrand, Johannesburg, South Africa
[2]Wits Sleep Laboratory, Brain Function Research Group, School of Physiology, University of the Witwatersrand, Johannesburg, South Africa
[3]Department of Internal Medicine, Division of Cardiology, Chris Hani Baragwanath Hospital, University of the Witwatersrand, Johannesburg, South Africa
[4]Department of Global Health and Amsterdam Institute for Global Health and Development, University of Amsterdam, Amsterdam, The Netherlands
[5]Department of Epidemiology, Biostatistics, and Occupational Health, Faculty of Medicine, McGill University, Montreal, Quebec, Canada
[6]Department of Global Health and Development, London School of Hygiene and Tropical Medicine, London, UK
[7]Julius Global Health, Julius Center for Health Sciences and Primary Care, University Medical Center Utrecht, Utrecht University, Utrecht, The Netherlands
[8]Division of Epidemiology and Biostatistics, School of Public Health, University of the Witwatersrand Faculty of Health Sciences, Johannesburg, South Africa
[9]Amsterdam University Medical Centers, Location VU Medical Center, Department of Global Health, Vrije Universiteit, Amsterdam, The Netherlands
[10]Department of Internal Medicine and Infectious Diseases, University Medical Center Utrecht, Utrecht University, Utrecht, The Netherlands

Twitter Samanta Tresha Lalla-Edward @Lalla-Edward

Acknowledgements The authors would like to thank the Centre for Statistical Analysis and Research (CESAR) for their support with the initial data cleaning and analysis and North Star Alliance for their assistance during participant recruitment.

Contributors Designed the study: AGV. Analysed the data and interpreted results: SL-E, AEF, RM, KS, AGV. Wrote the initial draft: SL-E, AEF, AGV. Contributed content to subsequent drafts: WDFV, CH, GG, KK-G, MD. All authors critically reviewed and approved of the final draft.

Funding This work was funded by North Star Alliance through a research and implementation grant received from the Ministry of Foreign Affairs of the Netherlands, managed by the Royal Dutch Embassy of Mozambique. The Amsterdam Institute for Global Health and Development and Wits RHI held separate contracts with North Star Alliance (AIGHD's grant reference: 0068 North Star – NSCDP; RHI's grant number: D1404070).The views of this study are those of the authors and do not necessarily reflect the views of any of the funders or the South African and Dutch governments.

Competing interests None declared.

Patient consent for publication Not required.

Ethics approval University of the Witwatersrand Human Research Ethics Committee approved this evaluation (reference number M160760). Participation was voluntary. A research nurse or counsellor who spoke the same language as the participant obtained informed consent. The three consent forms obtained for each participant were for study participation, HCT and storage of blood for further research. Participants received ZAR 150 and a shirt to compensate for their time.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request.

ORCID iDs
Samanta Tresha Lalla-Edward http://orcid.org/0000-0003-3597-1643
Alex Emilio Fischer http://orcid.org/0000-0002-6882-7245

REFERENCES

1 Lalla-Edward ST, Gomez GB. Enroute to a healthy truck driver population. *HIV Nurs. Matters* 2015;6:20–3.
2 Stats SA. *Statistical release: land transport (preliminary) October 2018*. Pretoria: Statistics South Africa, 2018.
3 Strauss M, George G, Lansdell E, *et al*. Hiv testing preferences among long distance truck drivers in Kenya: a discrete choice experiment. *AIDS Care* 2018;30:72–80.
4 Delany-Moretlwe S, Bello B, Kinross P, *et al*. Hiv prevalence and risk in long-distance truck drivers in South Africa: a national cross-sectional survey. *Int J STD AIDS* 2014;25:428–38.
5 Sieber WK, Robinson CF, Birdsey J, *et al*. Obesity and other risk factors: the National survey of U.S. long-haul truck driver health and injury. *Am J Ind Med* 2014;57:615–26.
6 Hege A, Lemke MK, Apostolopoulos Y, *et al*. Us long-haul truck driver work organization and the association with cardiometabolic disease risk. *Arch Environ Occup Health* 2017;72:303–10.
7 Du BB, Bigelow PL, Wells RP, *et al*. The impact of different seats and whole-body vibration exposures on truck driver vigilance and discomfort. *Ergonomics* 2018;61:528–37.
8 Olson R, Thompson SV, Wipfli B, *et al*. Sleep, dietary, and exercise behavioral clusters among truck drivers with obesity: implications for interventions. *J Occup Environ Med* 2016;58:314–21.
9 Romo ML, George G, Mantell JE, *et al*. Psychosocial characteristics of primary care-seeking long-distance truck drivers in Kenya and associations with HIV testing. *Afr J AIDS Res* 2018;17:119–28.
10 Lalla-Edward ST, Ncube S, Matthew P, *et al*. Uptake of health services among truck drivers in South Africa: analysis of routine data from nine roadside wellness centres. *BMC Health Serv Res* 2017;17:649.
11 Birdsey J, Sieber WK, Chen GX, *et al*. National survey of US long-haul truck driver health and injury. *J Occup Environ Med* 2015;57:210–6.
12 Lalla-Edward ST, Fobosi SC, Hankins C, *et al*. Healthcare programmes for truck drivers in sub-Saharan Africa: a systematic review and meta-analysis. *PLoS One* 2016;11:e0156975.
13 Boyce WS. Does truck driver health and wellness deserve more attention? *J Transp Health* 2016;3:124–8.
14 National Department of Health. *National HIV counselling and testing (HCT) policy guidelines*. Pretoria, South Africa: National Department of Health, 2010.
15 Prestage G, Song A, Grierson J. *Positive health: method and sample (monograph 9/2000*. Sydney: National Centre in HIV Social Research: The University of New South Wales, 2001a.
16 Prestage G, Song A, Grierson J. *Positive health: treatments, services and health (monograph 1/2001*. Sydney: National Centre in HIV Social Research: The University of New South Wales, 2001b.
17 Creel AH, Rimal RN. Factors related to HIV-testing behavior and interest in testing in Namibia. *AIDS Care* 2011;23:901–7.
18 DORIO C, Parsons M, Lehr S, *et al*. Measurement of safe sex behavior in adolescents and young adults. *Nurs Res* 1992;41:203–8. &.
19 Rosen RC, Cappelleri JC, Smith MD, *et al*. Development and evaluation of an abridged, 5-item version of the International index of erectile function (IIEF-5) as a diagnostic tool for erectile dysfunction. *Int J Impot Res* 1999;11:319–26.
20 Costa PT, McCrae RR. Normal personality assessment in clinical practice: the neo personality inventory. *Psychol Assess* 1992;4:5–13.
21 Blevins CA, Weathers FW, Davis MT, *et al*. The Posttraumatic Stress Disorder Checklist for *DSM-5* (PCL-5): Development and Initial Psychometric Evaluation. *J Trauma Stress* 2015;28:489–98.
22 Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. *J Gen Intern Med* 2001;16:606–13.
23 Johns MW. A new method for measuring daytime sleepiness: the Epworth Sleepiness scale. *Sleep* 1991;14:540–5.
24 Redman KN, Karstaedt AS, Scheuermaier K. Increased CD4 counts, pain and depression are correlates of lower sleep quality in treated HIV positive patients with low baseline CD4 counts. *Brain Behav Immun* 2018;69:548–55.
25 Cotes JE. Medical Research Council questionnaire on respiratory symptoms. correspondence. *Lancet* 1987;2:1028.
26 World Health Organization. *World health survey 2002*. Geneva: World Health Organization, 2002.
27 Ferris BG. Epidemiology standardization project (American thoracic Society). *Am Rev Respir Dis* 1978;118:1–120.
28 Mengersen K, Morawska L, Wang H, *et al*. The effect of housing characteristics and occupant activities on the respiratory health of women and children in Lao PDR. *Sci Total Environ* 2011;409:1378–84.
29 World Health Organization. *WHO steps surveillance manual*. Geneva: World Health Organization, 2017.

30 Canadian Centre for Occupational Health and Safety (CCOHS). *Medical history checklist: symptoms survey for work-related musculoskeletal disorders (WMSDs*. Government of Canada, 2019. https://www.ccohs.ca/oshanswers/diseases/work_related_WMSD.html
31 Alfakih K, Walters K, Jones T, *et al*. New gender-specific partition values for ECG criteria of left ventricular hypertrophy: recalibration against cardiac MRI. *Hypertension* 2004;44:175–9.
32 Ishikawa J, Yamanaka Y, Watanabe S, *et al*. Cornell product in an electrocardiogram is related to reduced LV regional wall motion. *Hypertens Res* 2019;42:541–8.
33 Sokolow M, Lyon TP. The ventricular complex in left ventricular hypertrophy as obtained by unipolar precordial and limb leads. *Am Heart J* 1949;37:161–86.
34 Okin PM, Roman MJ, Devereux RB, *et al*. Electrocardiographic identification of increased left ventricular mass by simple voltage-duration products. *J Am Coll Cardiol* 1995;25:417–23.
35 Boulos NM, Gardin JM, Malik S, *et al*. Carotid plaque characterization, stenosis, and intima-media thickness according to age and gender in a large registry cohort. *Am J Cardiol* 2016;117:1185–91.
36 Naqvi TZ, Lee M-S. Carotid intima-media thickness and plaque in cardiovascular risk assessment. *JACC Cardiovasc Imaging* 2014;7:1025–38.
37 Lang RM, Badano LP, Mor-Avi V, *et al*. Recommendations for cardiac chamber quantification by echocardiography in adults: an update from the American Society of echocardiography and the European association of cardiovascular imaging. *Eur Heart J Cardiovasc Imaging* 2015;16:233–71.
38 Rudski LG, Lai WW, Afilalo J, *et al*. Guidelines for the echocardiographic assessment of the right heart in adults: a report from the American Society of echocardiography endorsed by the European association of echocardiography, a registered branch of the European Society of cardiology, and the Canadian Society of echocardiography. *J Am Soc Echocardiogr* 2010;23:685–713.
39 Centers for Disease Control and Prevention. Defining adult obesity; adult body mass index (BMI), 2017. Available: https://www.cdc.gov/obesity/adult/defining.html [Accessed 2 May 2019].
40 Seedat YK, Rayner BL, Veriava Y. South African hypertension practice guideline 2014 : review article. *Cardiovasc J Afr* 2014;25:288–94.
41 International Diabetes Federation. *IDF diabetes atlas*. Seventh Edition. Brussels: IDF, 2015.
42 National Department of Health (NDoH), Statistics South Africa (Stats SA). *South African medical Research Council (SAMRC), and ICF. 2019. South Africa demographic and health survey*. Pretoria, South Africa, and Rockville, Maryland, USA: NDoH, Stats SA, SAMRC, and ICF, 2016.
43 Statistics South Africa. *Mid-year population estimates 2018. statistical release P0309.3*, 2018.