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Article

Sociodemographic and Economic Profile of Bicycle-Taxi Riders and Revenue Modelling in Quelimane, Mozambique

Artele Freitas Jone[1], Solomon Runhungwe[2] and João L. Ferrao[3*]

[1] Faculdade de Economia e Gestão, Universidade Aberta ISCED, ajone9@isced.ac.mz
[2] Faculdade de Engenharia e Agricultura, Universidade Aberta ISCED, srumhungwe@unisced.edu.mz
[3] Faculdade de Engenharia e Agricultura, Universidade Aberta ISCED, jferrao@inisced.edu.mz, orcid.org/0000-0002-3660-8275
* Correspondence author

Abstract: Bicycling is a tremendously efficient means of transportation both in socio-economic and environmental sustainability parameters. Therefore, they are fast becoming the primary mode of transportation in some other parts of Africa. Quelimane is a city which is found in Mozambique where bicycle-taxi is a major means of transportation. However, very little is known about the social and economic profiles of these city bicycle-taxi riders. Hence, the aim of this study was to determine the socio demographic and economic profile of bicycle-taxi riders. A cross-sectional study survey using a simple random probabilistic sample (n = 357, α = 0.05) was conducted. The questionnaire consisted of 20 items in five major groups, sociodemographic, economics, riding factors, safety and motivational factors. Pearson Chi square, t test and linear regression tests were carried out to test for statistical analysis. The activity is carried out mostly by males (98.9 %), under the age of 35 years. Their academic records, ranking highest, with secondary education background, bicycles are obtained through rental programs in order to perform taxing. After expenses, daily earnings generate a total revenue of USD 5.75. Sex, marital status, house type, years riding, bicycle make and meal per day, are associated with daily revenue income. Bicycle-taxi activity in Quelimane is an income generating activity. Mainly young citizens are involved due to the high unemployment rate. Nonetheless, bicycle taxing created an untapped market for self-employment, where the majority of youths in Quelimane generate their own revenue, thereby improving their livelihood.

Keywords: bicycle taxi; profile; sociodemographic; economic; degree of satisfaction

1. Background

Non-Motorized Transport (NMT) are also called active transport and human powered transport, which refers to walking, cycling, handcart and other variants and they play an important and efficient role in the transport system (Vanderschuren, 2012).

Bicycling is a tremendously efficient means of transportation, as compared to walking for example, a bicycle can be up to five times more efficient than walking. To add on, when comparing the same amount of energy burned by a car to bicyclist, one hundred calories can power a cyclist around 5 km, but the same can only power a car 85 meters (Exploratorium, 2018).

The following distinctions were identified when comparing cyclists commuting to cars and motorcycles: environmentally sustainable, faster mobility in busy urban areas, improved public health, vitality and pleasure, affordable, improved user convenience (Litman, 2012).

This enterprise started in Africa as early as the 1930s in Senegal. They then emerged in Uganda and Kenya in the 1960s gaining popularity to other countries in the 1990s. This was a result of border closures and economic crises that arose due divestiture of public

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enterprises and economic liberalization, which led to a proliferation of informal trading and enterprise (Manda, 2014).

The overall health benefits of cycling are tremendous, since it reduces the cerebrovascular accidents incidence, coronary arteries diseases, hypertension, dyslipidemia, obesity, diabetes and there is a strong inverse relation between cycling and all-cause mortality and cancer mobility among middle-aged and elderly individuals (Lee & Breyer, 2020)]. Despite these benefits, cycling has been also associated with urological diseases such as prostatitis, nimbleness, priapism, infertility and others. Moreover, bodies are fueled by food and diet plays an important role in cycling. If cyclists eat less energy than expended in cycling, unexplained fatigue and more long-term energy deficiency, including poor bone health, mental issues, infertility and others may develop (Mccubbin, 2018).

In Mozambique proportionally, the total province population as per assert ownership, 29.1 % of the households own a bicycle, 8.1 % a motorcycle and 4.2 % a car. The percentage of car owners is higher in Maputo Province, 18.1 % and lower in Niassa Province, 1.5 %, while the ownership of bicycles is inverse, Niassa 50 % and Maputo, 8.5 %. In Zambézia province, the ownership of bicycles is 41 %(INE, 2017) .

The Quelimane city in Zambézia province, was once a prolific producer of coconut, fishing and rice industries which declined drastically in the past years. Currently, the city experiences high levels of poverty and unemployment, the residents rely heavily on small-scale informal trading. In the city, bicycles are not only used for commuting, but also for taxi services and for carrying and delivering all sorts of goods (Mendiate, 2019). It is estimated that around 10,000 bicycles commute daily in the city and 5,000 bicycle-taxi raiders are registered in the association.

However, very little is known about the social and economic profiles of these city bicycle-taxi riders, including their living environment, eating habits, income, day-to-day difficulties, degree of satisfaction and among other aspects that can help decision-makers and planners to improve assistance to this group. Therefore, the aim of this study was to determine the socio demographic profile of bicycle-taxi riders and factors that influence the daily revenues in the activity.

2. Study settings

2.1. Study area

The survey was carried out between April and May 2022 in Quelimane city, a sea port in Mozambique, it is the administrative capital of Zambézia Province, located in the Central region of Mozambique (Figure 1).

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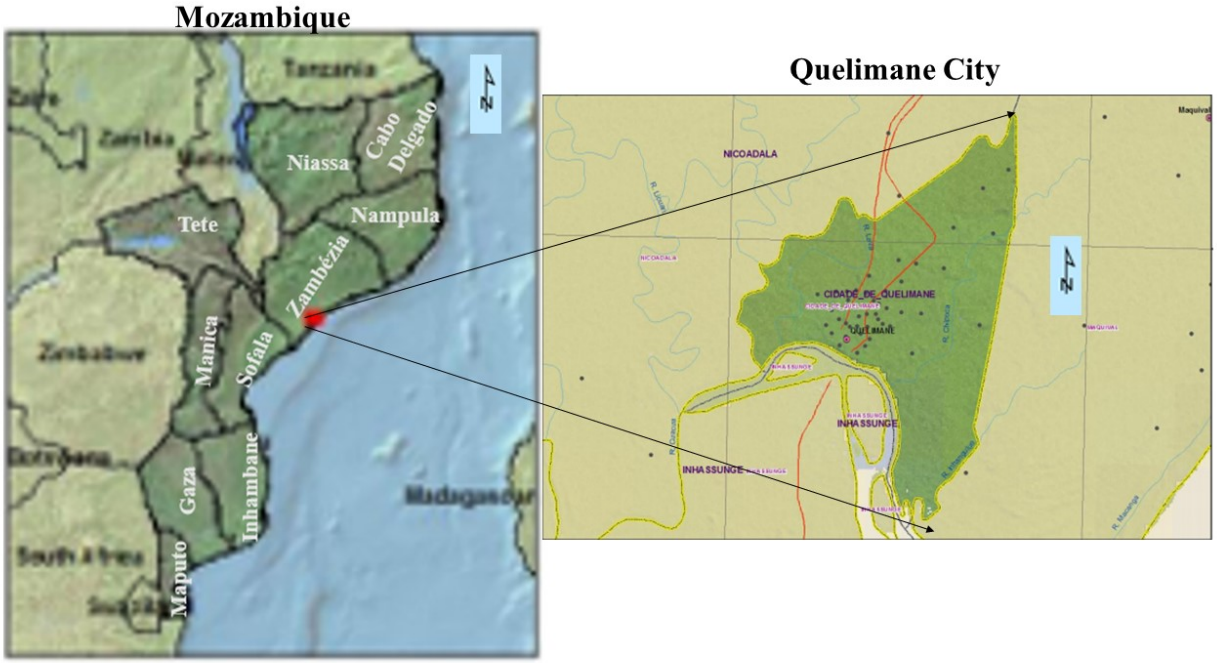

Figure 1. Study area. Adapted from (INE, 2017)

It is geographically limited by the Nicoadala district to the northwest, Inhassunge to the south and the Indian ocean to the east, between 17° 47′ – 17° 57′ South and 36° 50′ – 36° 57′ East, it has currently 5 administrative posts and 59 neighborhoods (UCCLA, 1985). The average altitude is 9 meters ranging from -2 meters to 23 meters above sea level, conducive to bicycle riding. The area of the city is 117 Km², a population of around 400,000 inhabitants. Fishing is one of Quelimane's main economic activities, in addition to agriculture (FUNÇÃO & (MAEFP), 2020). Data from the National Institute for Statistic (INE) indicate that the population of the Municipality of Quelimane has slightly more women (51.6%) than men (48.4%) (ESTATISTICA, 2019).

The climate of Quelimane is tropical, with a hot, rainy season from November to April and a relatively cool season from June to August. Intense heat waves may occur from September to December, that is before the rain season. Temperatures range from 16.5ºC to 34.3ºC, the average temperature of the coldest month (July) is of 21.4ºC and of the warmest month (December) is of 28.7ºC (Pegasusweb, 1991).

For a daily routine, it is estimated that 40 % of the city residents walk, 35 % cycle, 17 % uses motor vehicles, 7.6 % motorcycles and 0.4 % tricycles and the municipality has a classified road network of about 132 km, of which 69 km are main roads, 46 km are secondary roads and 18 km are tertiary roads, 25 % of the roads are paved and 75 % non-paved. [(Mendiate, 2019) ,(FUNÇÃO & (MAEFP), 2020)].

2.2. Study design and data collection

A cross-sectional study survey was administered using structured data from March to May 2022 in Quelimane city to which bicycle riders personally approached. A simple random probabilistic sample was obtaining using the formula:

$$n = \frac{\frac{Z^2 x\ p\ (1-p)}{e^2}}{1+(\frac{Z^2 x\ p\ (1-p)}{e^2 N})} \quad (1)$$

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Where: n = sample size, N = population size, e = N = population size, e = margin of error, z = confidence level. With a registered population of 5,500 taxi-bicycle riders, the sample consisted of 357 individuals, margin of error 5 % and confidence interval 95 %.

The enrollment eligibility criteria were full-time resident that carries a bicycle taxi rider activity and the used questionnaire consisted of 20 items in five major groups: i) sociodemographic (age, sex, marital status, academic level, residence, provenience, household size and years riding,, ii) economics (daily income, other sources of income, ,price per trip, bicycle ownership, bicycle type and bicycle rent charges), iii) Riding factors (number of meals a day and distance ridded a per day), iv) Safety (Activity risks factors and risk neighborhoods) v) Motivational (reasons for the activity and degrees of satisfaction). The data are in https://doi.org/10.7910/DVN/JZGLFZ.

2.3. Data analysis

Descriptive statistics were calculated, Pearson Chi square test was used for non-parametric variables and were compared to population variables from INE (ESTATISTICA, 2019). To test statistical difference in parametric variables, t test was performed. To establish association between dependent (daily revenues) and independent variables, linear regression tests were conducted. The linear regression model was:

$Y = a + bX$ (2)

Where X is the independent variable and Y is the dependent variable. The slope of the line is b, and a is the intercept (the value y when $x = 0$) (University, 2020).

To avoid multicollinearity, that is a situation when two or more independent variables are highly correlated, a test was performed and variance inflation factor (VIF) was calculated and variables with a VIF greater than 2.5 removed (Senaviratna & Cooray, 2019).

Gross profit margin was calculated by subtracting direct expenses (daily bicycle rent) from the gross revenues (daily revenue). Then, divided by gross revenue, the multiplied 100 (Company, 2021) and bicycle daily rent was considered the direct cost.

$Gross\ profit\ margin\ ratio =$ (Net revenue – direct expenses) Net revenue x 100% (3)

Data were entered in an Excel spreadsheet and analyzed using SPSS 20 version 20 and BioEstat 5.3 version [(IBM, 1998),(Ayres & Junior Ayres, 2000)] and a 5 % significance level was considered.

3. Results

3.1. Demographic characteristics

The demographic characteristics are presented in table 1.

Table 1. Sociodemographic characteristics of Quelimane Tax-Bicycle riders.

Variable	Bicycle riders mean	CI (95 %) Lower	CI (95 %) Upper	sig,
Age	30.5	29.9	31.0	.000
	Bicycle riders % (*n*)			< 0.0001
19 – 35	88.5 (316)			
36 – 48	11.5 (12)			
Household size	6.3	6.1	6.4	.000
	Bicycle riders % (*n*)			
< 5	7.3 (26)			
5 to 10	91.6 (327)			
> 10	1.1 (4)			
Years riding	9.7	9.4	10.1	.000
Sex	Bicycle riders % (*n*)			
Male %	98.9 (353)			< 0.0001
Female %	1.1 (4)			
Education				< 0.0001
Non	9.2 (33)			

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Primary	27.7 (99)	
Secondary	27.1 (97)	
Medium	35.0 (125)	
Higher	0.8 (3)	
House ownership		< 0.0001
Self-owned	13.7 (49)	
Rent	66.1 (236)	
Family	20.2 (72)	
Current residence		< 0.0001
Quelimane	59.9 (214)	
Nicoadala	4.8 (17)	
Madal	5.9 (21)	
Inhassunge	29.4 (105)	
Marital status		< 0.0001
Single	15.6 (57)	
Married	2.5 (9)	
“de facto” union (3)	81.2 (290)	
Divorced	0.3 (1)	

CI = Coefficient interval, sig, = Level of significance (5 %), p = probability.

The age of the tax-bicycle riders ranges from 19 to 48 years, with median age = 31 and an average age of 30.5 (CI = 29.9 to 31). The majority of the commuters, 88.5 %, have less than 35 years. The average household size is 6.3 (CI = 6.1 to 6.4). interquartile deviation = 2, 91.6 % of the households with 5 to 10 members.

The household size (6.3) of the bicycle taxi-riders is higher than the Mozambique average size (4.4), $t = 76.0363$, $p < 0.0001$. The years carrying out the bicycle taxi activities varies from 3 to 20, average 9.7 (CI = 9.4 to 10.1).

There is huge disproportion on the sex of taxi-bicycle riders, 98.9 males and 1.1 females, Chi-square = 60.063, $p < 0.0001$, comparing with the sex of Quelimane population.

As per level of education, 9.2 % of the tax-bicycle riders are non-educated, 27.7 % have primary education, 27.2 % basic education, 35 % medium education and 0.8 higher education. There is a difference between the education level of the Mozambican population and the tax-bicycle riders, Chi-square = 71.262, $p < 0.0001$. As per house ownership, the majority, 66.1% of the taxi-bicycle riders rent a house, 13.7 have their own house and 20.2 live in the house belonging to their relatives.

There is a difference between house ownership of the Mozambican population and the tax-bicycle riders, Chi-square = 59.385. $p < 0.0001$.

Around 60 % of the taxi-bicycle riders are from Quelimane city, 29 % from Inhassunge, 6 % from Madal and 5 % from Nicoadala. There is a statistical difference in the origin of the taxi-bicycle riders, Chi-square 39.687, $p < 0.0001$. As per marital status, 81 % of the taxi-bicycle riders’ lives in Uniao de Facto, 16 % are single, 2.5 % legally married and 0.3 % divorced, there is a statistical difference between the marital status of the taxi-bicycle comparing to the Mozambican ones, Chi-square = 30.961, $p < 0.0001$ comparing to the Mozambique population.

3.2. Economic characteristics

The economic variables are presented in table 2. The average price per trip is 18.5 Meticais (0.29 US $) (CI 18.1, 18.9), the taxi-rider daily revenue per day is 367 Meticais (5.75 US $) (CI 352, 382). The bicycle rent per day is 106 Meticais (1.66 US $) (CI 103, 109), gross profit of 4.09 US $ a day and a gross profit margin ratio of 71.1 %.

As per source of income, 89 % of the tax-bicycle riders operate full time, 5 % have income from wages, 2 % they carry other business and 4 % have other sources of income. As per bicycle ownership almost half of the tax-bicycle operators rent their bicycles for their activities, 30 % use bicycles from their relatives and around 1 in five operators have their own bicycles. The majority of taxi-bicycle operators ride a 26 bicycle and 29 % a 28 bicycle.

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Table 2. Economic variables of taxi-bicycle riders in Quelimane, 2022.

Variable	Bicycle riders average	CI (95 %) Lower	CI (95 %) Upper	Sig
Price per trip	18.5	18.1	18.9	.000
Daily revenue	367	352	382	.000
Rent per day	106	103	109	.000
Sources of Income	**Bicycle riders %** (*n*)			< 0.0001
Business	2 (5)			
Wage	5 (17)			
Taxi-bicycle	89 (318)			
Others	4 (16)			
Bicycle ownership				0.0796
Self-owned	22.1 (79)			
Rent	47.9 (171)			
Relative	30 (107)			
Bicycle type				0.0029
26	70.6 (252)			
28	29.4 (105)			

CI = Coefficient interval, sig,= Level of significance (5 %).

3.3. Riding factors

Table 3 presents the riding trends of the Quelimane tax-bicycle riders. On average they ride 35.2 Km a day (CI 34 to 36.4), Q1 = 30 Km, Q3 = 50. The average meal a day is 2.2 (CI 2.1 to 2.2). Around 5 % of them have only one meal a day, 73.7 % two meals and 21.8 % afford to have three meals a day.

The taxi-bicycle riders' concerns are presented in table 3 and the major concern 61.6% is accidents and 38.9 % theft and no statistical difference exists between them. Out of 59 neighborhoods, they have concerns with 4 of them being the most insecure neighborhoods, Torrone (63.6 %) followed by Icidua (20.4 %), Janeiro 8.7 % and Chiringano 7.3 %.

Table 3. Riding trends of the Quelimane tax-bicycle riders

Variable	Bicycle riders mean	CI (95 %) Lower	CI (95 %) Upper	sig,
Km ridded daily	35.2	34	36.4	.000
No meals a day	2.2	2.1	2.2	
	Bicycle riders % (*n*)			< 0.0001
1	4.5 (16)			
2	73.7 (263)			

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3	21.8 (78)			
Degree of satisfaction	2.9	2.8	3.0	.000
	Bicycle riders % (*n*)			
Very unsatisfied	4.2 (15)			
Unsatisfied	18.2 (65)			
Satisfied	60.8 (217)			
Very satisfied	16.8 (60)			
Risk factors				0.1142
Theft	38.9 (136)			
Accident	61.1 (218)			
Insecure neighborhood				< 0.0001
Torrone	63.6 (227)			
Janeiro	8.7 (31)			
Chiringano	7.3 (26)			
Icidua	20.4 (73)			
Reasons for the activity				< 0.0001
Unemployment	99.2 (354)			
Enjoyment	0.8 (3)			

CI = Coefficient Interval, Sig = level of significance (5 %).

3.4. Motivational aspects

The taxi-bicycle motivational aspects are presented in table 3. As per reasons to carry out the activity, 99.2 % of them do it due to lack of employment and 0.8 % for enjoyment. As per degrees of satisfaction, 4.2 are very unsatisfied, 18.2 % unsatisfied, 60.8 % are satisfied and 16.8 % very satisfied with the taxi bicycle Figure 2 presents the degree of satisfaction for the taxi-bicycle rider and with an average of 2.9 (CI 2.8 to 3) out of 4 points.

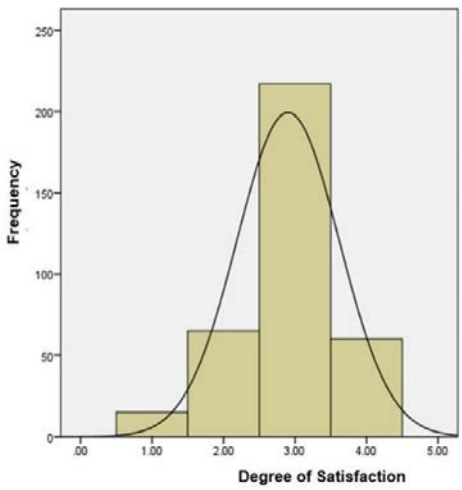

Figure 2. Taxi-bicycle degree of satisfaction.

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3.5. Regression analysis

Tables 5 presents the regression model summary and the coefficient of correlation (R) is good (56.1 %). The model coefficient of determination (R^2) was 0.351 implying that the combined effect of the predictor variables in the present study affects daily revenue of taxi bicycle riders by a margin of 31.5 %.

Table 5. Taxi-bicycle linear regression summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.561[a]	.315	.289	122.4

a. Dependent Variable: Daily revenue, R = Correlation coefficient, R^2 = Coefficient of determination.

Table 6 presents the ANOVA results and the model is statistically significant as the p-value is less than 0.05 and the regression model statistically predicts the outcome variable, indicating a good fit for the data (F= 12.130, p = 0.000).

Table 6. ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	2361022.1	13.0	181617.1	12.130	.000[b]
	Residual	5135773.4	343.0	14973.1		
	Total	7496795.5	356.0			

a. Dependent Variable: Daily revenue, Df = degrees of freedom, F = Fisher.

Table 7 presents the linear regression coefficients and 5 variables were removed from the model since the VIF was higher than 2.5.

	Unstandardized Coefficients				95.0% Confidence Interval for B		
	B	Std. Error	*t*	Sig.	Lower Bound	Upper Bound	VIF
(Constant)	1149.7	266.5	4.3	**0.00**	625.4	1673.9	
Age	0.7	1.5	0.4	0.66	-2.3	3.6	1.7
Sex	-184.8	67.1	-2.8	**0.01**	-316.7	-52.9	1.2
Marital status	45.5	10.3	4.4	**0.00**	25.3	65.8	1.4
Education	-2.7	6.8	-0.4	0.69	-16.2	10.7	1.1
House type	30.5	15.0	2.0	**0.04**	1.1	60.0	1.8
Household size	4.1	4.7	0.9	0.38	-5.1	13.3	1.2
Years riding	11.1	2.1	5.4	**0.00**	7.0	15.1	1.3
Sources of income	14.8	19.3	0.8	0.44	-23.1	52.6	1.4
Charge per trip	-3.7	2.1	-1.8	0.08	-7.7	0.4	1.4
Bicycle make	-31.3	7.9	-4.0	**0.00**	-46.7	-15.8	1.2
Meal per day	-67.2	17.5	-3.8	**0.00**	-101.6	-32.9	1.7
Reasons for activity	28.1	37.2	0.8	0.45	-45.0	101.2	1.1
Degree of satisfaction	16.2	10.2	1.6	0.11	-3.9	36.3	1.3

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a. Dependent Variable: Degree of satisfaction, *B* = Coefficient of regression, Std. = standard, *t* = students, Sig = level of significance, VIF = Value Inflation Factor.

The daily revenues contribute significantly to the model (p = 0.000) and Sex (β = -184.8, p = 0.01), bicycle make (β = -31.3, p = 0.00), meal per day (β = -67.2, p = 0.00) were negatively and significantly related to daily revenue while, marital status (β = 45.5, p =0.00) house tipe (β = 30.5, p = 0.04) and years of riding (β =11.1, p = 0.00) were positively and significantly related to daily revenue.

The multi-linear regression equation can be written as:

$$Y = 1149.7 - 184.8\ \text{sex} + 45.5\ \text{marital status} + 30.5\ \text{residence} + 11.1\ \text{years riding} - 31.3\ \text{bicycle make} - 67.2\ \text{daily meals} \quad (1)$$

Figure 3 presents the regression standardized residuals (A) and Regression standardized predicted value (B) and normal and the data meet the assumptions of linear regression.

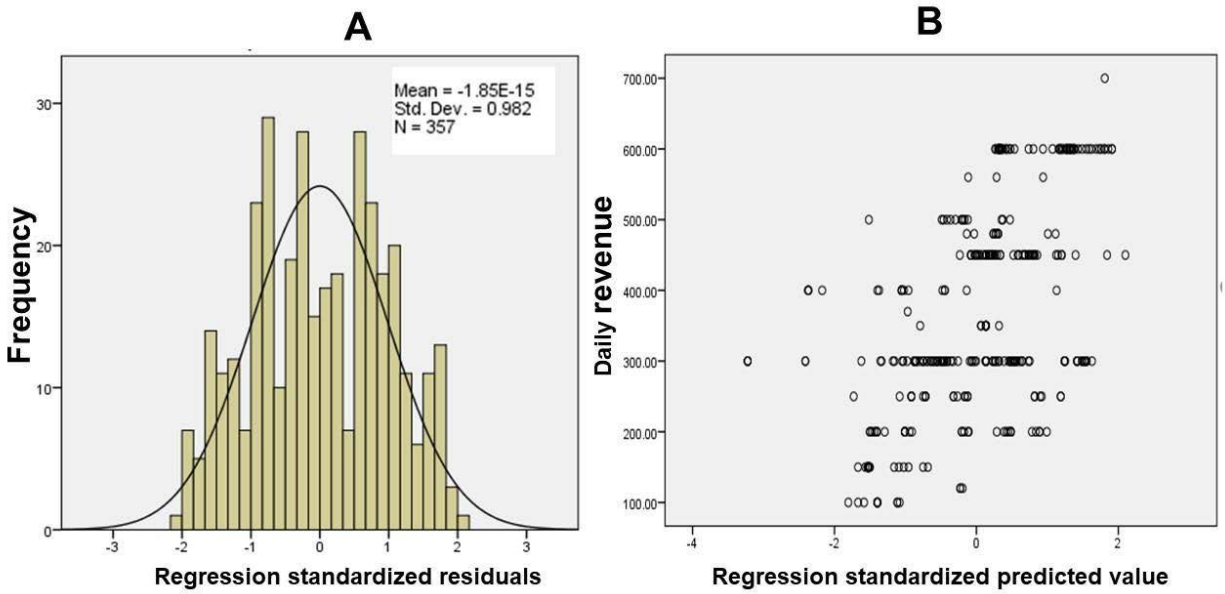

Figure 3. Regression standardized residuals (A) and Regression standardized predicted value (B)

4. Discussion

The objective of this study was to understand their social and economic profile, the environment in which they live, their eating habits, income, their day-to-day difficulties, their degree of satisfaction, among other aspects.

The taxi-bicycle riders are predominantly males (98.9 %) and young (88.5 %) between 19 to 35 years old. Male dominance tendency in this activity was previously reported in Quelimane (Mendiate, 2020) in 2020, and in other African countries, such as Kisumu, Nakuru, Kenya in 2011, in Kisumu, Kenya in 2013, in Tanzania in 2021 and South Africa [(Mutiso & Behrens, 2011), (Kokwaro et al., 2013), (Gikuri & Chetto, 2021), (Bechstein, 2010; Gikuri & Chetto, 2021)]. This tendency may be explained due to the activity nature that requires strength to pedal the bicycle (Kokwaro et al., 2013).

The average age of the taxi-bicycle operators in this study is slightly higher than the reported in Zambia (Bechstein, 2010) in 2007, between 15 to 35 years, in Kenya in 2011 (Mutiso & Behrens, 2011) between 24 to 27 years and in Tanzania (Gikuri & Chetto, 2021) in 2020 with a range between 21 to 35 years old. High rates of unemployment in

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Quelimane and the fact that young people are physically more capable of carrying out the activity may explain the tendency.

In this study, major (62.1 %) taxi-driver riders have secondary or medium level of education (98.9 %) are married (83.7 %) with a large household size (n = 6.3).

Similar results were previously reported in Quelimane (Mendiate, 2020) differing from other African countries where education level of taxi bicycle rider is lower, in Kenya it was reported mostly illiterate, dropouts and primary school (Mutiso & Behrens, 2011), (Gikuri & Chetto, 2021).

The disparity in education may represent African countries' different preparation and lack of vocational training schools in Mozambique. As per marital status, this study presents a higher proportion of married people compared to a study in Tanzania (Kokwaro et al., 2013) .

The household size in the present study is higher than in Mozambique, in Kenya slightly higher household size of taxi bicycle riders were also reported (University, 2020). The economic crisis in Mozambique in general and the decline in coconut, fishing and rice industries that resulted in high levels of poverty and unemployment in Quelimane explains why head family members have to venture in bicycle taxi riding due to increased family responsibility.

In this study, the average years in the taxi bicycle activity was 9.7 (LI 9.4 to 10.1), most of them rent their houses (66.1 %), and 59.9 % are from the Quelimane city and the rest come from the surrounding areas.

In Tanzania (Bechstein, 2010), 3.5 to 4.7 years of riding were reported. The renting house rate in this study is higher than reported in Tabora Tanzania, 59.8 % and Shinyanga, 31.2 % in Tanzania [(Bechstein, 2010) in 2020. The tendency of having bicycle taxi riders from areas different from the city to specifically carry out the business was also reported in Kenya (Mutiso & Behrens, 2011) and Tanzania (Starkey, 2007) in 2022.

The average taxi-rider daily revenue in this study was 367 Meticais (5.75 US $) and daily net profit of 261 Meticais equivalent to 4.09 US$. In Rwanda [24], daily revenue of 3 to 4 US $ were reported in 2017, 2.8 to 4.2 US$ in Tanzania (Kokwaro et al., 2013; Räber, 2014) in 2020, in Malawi (Forks, 2017) 6.6 US$ a day and in Iringa Tanzania 0.11 to 0.12 US$ cents per Km was reported (Manda, 2014). equivalent to a revenue of 3.85 to 4.2 US$ a day, all of them lower than earning in Quelimane.

The higher daily revenue in Quelimane is because it is a city and the other studies are from rural areas. Higher income in urban areas was also reported in Kenya and India, due to higher mobility demand among city residents compared to rural (Bechstein, 2010).

In this study, 89 % of the taxi-bicycle riders are fully employed in the activity with no other income activities, only 22.1 % have their own bicycle and the rest hire or use relatives' bicycles and 70%. 6 % of them use the 26 inches roadster bicycles.

In Tanzania two-thirds of the taxi-bicycle riders own their bicycles (Starkey, 2007) higher than the present study, in Kenya (Kokwaro et al., 2013) 11 % of self-owners were reported in 2013, lower than the present study.

The type of bicycle mostly ridded is consistent with other studies that reported that roadster bicycles type without gears are more used since they are cheap to operate, with lower cost to repair (Räber, 2014). Finding a spare 26-inch tire, tube, rim or entire wheel is much easier in Central Asia and Africa. They are stronger, meaning that they can handle heavier loads, the parts are cheaper, have increased maneuverability, they are lighter bringing down the total weight of the bicycle using less energy to ride, and they are faster (Forks, 2017).

In this study, the bicycle taxi riders daily average is 35.2 Km (range 17 to 60 Km) and, most of them (73.7 %) have two meals a day. Previous study in Quelimane (Mendiate, 2020) reported lower distances, averaging 6 Km. In Iringa, Tanzania (Starkey, 2007) cycling medium distance of 10 to 40 Km are common and in Luapula Province in Zambia (Musonda, 2007), bicycle journeys of 10 Km are common and up to 50 Km not unusual.

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For maintenance a person needs 1500 to 2000 Calories of energy a day. Cycling requires an extra amount of around 2000 Kcal(Pettinger, 2014). Most cyclists in this study have two meals a day, not enough to fulfill the daily energy requirements.

As per reasons to carry out the bicycle taxi activity, almost all of them (99.2 %) are due to unemployment. Unlike developed countries, in developing countries, bicycles are used primarily for commuting rather than simple leisure (Shaaban, 2020).

Accidents (61.1 %) and theft are the main risk factors for the profession. Bicycles belong to the category of vulnerable groups on the road. Lack of proper infrastructure for cycling in Africa tends to increase the accidents (Yannis et al., 2020). On-road conflicts with motor traffic was mentioned as a major concern in Kenya (Mutiso & Behrens, 2011). Cyclists and pedestrians belong to the category of vulnerable groups on the road and have more serious accident risks (Ma et al., 2019).

In terms of dangerous neighborhoods, four out of 59 neighborhoods were pointed as the most dangerous, especially Torrone (63.6 %) and Icidua (20.4 %). Torrone is considered one of the neighborhoods with the highest rate of criminality, where some cases of robbery end in deaths. This neighborhood is also related to drug trafficking. In Icidua neighborhood there is a dense mangrove and there is a lack of street lighting, leading to criminal actions.

In terms of degree of satisfaction, the bicycle taxi riders, 77.6 % are satisfied or very satisfied. In an economically harsh situation, riding a bicycle contributes to the livelihood of the Quelimane citizens.

Five variables were removed from the final model due to collinearity over 2.5 and in the final model VIF was lower than 1.9, therefore ruling out any chances of multicollinearity presence. VIF higher than five is a concern in weaker regression models (Senaviratna & Cooray, 2019). ANOVA results indicated a good fit for the data and consequently the regression model is a good fit of the data. The model coefficient of determination (R^2) was 0.351 in this study, similar to reported in Tanzania (Bechstein, 2010).

Sex, marital status, house type, years riding, bicycle make and meal per day were found predictors for daily revenue income. Contrary to a study in Tanzania (Bechstein, 2010) finds only age and the current residential status as predictors.

Conclusion

Taxi bicycle activity in Quelimane is an income generating activity. Its target group is mainly young citizens due to unemployment. It generates a gross margin profit of 4.09 US dollars a day. The activity provides an opportunity for income generation for a large number of young self-employed residents who as taxi bicycle riders improve their livelihood. Also, most of them are satisfied with the activity. It is important to note that the introduction to traffic rules, rider's awareness of the cyclist and appropriate infrastructures such as bicycle lanes and nutritional education may improve the activity and the revenue of the taxi bicycle riders.

Limiting factors

Although in this study the daily gross profit is 4.09 US $, over than the poverty line (Bank, 1995), the study did not access the number of household members earning wage.

Ethics consideration

Participants were provided with information about the study objectives and the study was conducted in compliance with the ethical standards of the institutional research committee, respecting the 1964 Helsinki Declaration and respective amendments. Permissions were granted by the Associacao dos Taxi-biciletas and Municipio de Quelimane and cleared by the Research Department of Open University ISCED.

Declarations

Consent for publication: N/A

Availability of data: Data attached in additional file

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Authors' contributions: AFJ contributed in data collection, SR contributed in English manuscript revision and JLF contributed in data analysis and manuscript writing.

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