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Patterns of non-communicable disease and injury risk factors in Kenyan adult population: a cluster analysis

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Background: Non-communicable diseases and unintentional injuries are emerging public health problems in sub-Saharan Africa. These threats have multiple risk factors with complex interactions. Though some studies have explored

Achieving the 25*25 target, which is the reduction of premature mortality from four main NCDs—cardiovascular diseases, chronic respiratory diseases, cancers, and diabetes—by 25% from 2010 levels by 2025 [7] will very much depend on achieving the risk factor target on the key risk factors for NCDs (tobacco and alcohol use, salt intake, obesity, and raised blood pressure and glucose) [7].

3 Clusters of NCD risk factors by background variables

SN	NCD Risk Variables	Hypertensives	Harmful users	Hopefuls	The obese	Fat lovers	p-value
1	Age						
	18–29	23.9	19.5	43.9	20.0	40.1	< 0.001
	30–44	29.3	43.8	36.0	42.8	39.8	
	45–59	27.0	24.6	14.9	26.1	14.4	
	60–69	19.9	12.1	5.3	11.1	5.6	
2	Sex						
	Female	53.7	12.9	58.8	78.1	56.3	< 0.001
	Male	46.3	87.1	41.2	21.9	43.7	
3	Residence						
	Rural	55.9	57.0	50.1	41.4	60.0	< 0.001
	Urban	44.1	43.0	49.9	58.6	40.0	
4	Education						
	No schooling	20.0	13.2	18.6	11.4	16.5	< 0.001
	Primary incomplete	21.0	35.3	24.2	20.3	29.0	
	Primary complete	32.6	28.3	27.8	33.4	35.1	
	Secondary+	26.4	23.2	29.4	34.9	19.4	
5	Employment						
	Employed	45.9	30.2	43.1	33.7	47.2	< 0.001
	Unemployed	54.1	69.9	56.9	66.3	52.8	
6	Wealth index						
	Poorest	20.0	25.7	24.5	8.1	26.6	< 0.001
	Second	23.0	24.6	18.2	12.9	27.3	
	Third	24.4	19.9	17.1	21.2	20.0	
	Fourth	18.4	18.0	19.2	23.7	17.7	
	Richest	14.2	11.8	20.9	34.1	8.5	
7	Marital status						
	Not in Union	34.2	37.5	36.2	27.1	30.4	< 0.001
	Union	65.8	62.5	63.8	72.9	69.6	

NCD

was employed to determine patterns of NCD and injury risks and this segmented the population into five heterogeneous NCD risk clusters and four injury risk clusters. Two of the NCD risk clusters named fat lovers (23%) and harmful users (7%) demonstrated patterns consistent with three known behavioural NCD risk factors- unhealthy diet, tobacco smoking and harmful use of alcohol, and two NCD risk clusters referred to as the obese (26%) and the hypertensive (14%) fell in the physiological NCD risk group. One cluster had no extreme NCD risk. However, in all clusters fruit and vegetables consumption was way below the recommended five servings per day and physical inactivity was not common.

These findings are consistent with literature from rural and urban settings in Kenya highlighting that the burden of NCDs is driven by all the known behavioural and physiological NCD risk factors but not physical inactivity [14–16]. Recent publications from other countries in East Africa have revealed similar findings of dietary habits characterised by poor consumption of fruits and vegetables and a high consumption of fats and carbohydrate amidst adequate physical activity [17, 18], a pattern typical of an early phase of nutrition transition [19].

Our study has identified distinct population groups with prevalent NCD risk factors for targeted interventions. It is interesting to note that the smallest NCD risk cluster represents tobacco consumption, harmful alcohol consumption and excessive salt use. The lower frequency of harmful alcohol use and tobacco smoking may be a reflection of the relative success in the development and implementation of policies addressing the WHO “best buy” interventions for NCD prevention. These policies should ideally include measures to reduce common NCD risk factors such as tobacco use, unhealthy diet, physical inactivity

and the harmful use of alcohol – that would deliver the greatest benefit in reducing population level risks in a cost-effective manner [20].

A recent NCD prevention policy review for Kenya revealed a fairly better formulated tobacco control policy addressing all WHO "best buy" interventions such as tax increases, bans on tobacco advertising, and warnings on the dangers of tobacco; a weak alcoholic drinks control act (ADCA) addressing some of the "best buy" interventions including taxation and restriction to alcohol access; and a deficient food and nutrition policy not adequately addressing "best buy" interventions for unhealthy diet [21]. Although physical activity policies are not given priority, no cluster emerged with physical inactivity as the main risk factor because most people are active through work and travel other than recreation [22].

For injuries, 62% of the population was classified into two high risk injury clusters referred to as the defiant (36%) for not using seatbelts and jaywalkers (26%) because of inappropriate road crossing. The remaining two clusters which were low risk included helmet users (33%) and the compliant (5%) who used belts

consistently and crossed roads appropriately. A recent survey conducted in five regional referral hospitals in Kenya showed that road traffic accidents were the most common injury among patients admitted in the emergency department and this is consistent with the clustering of risk factors at population level in this study [23]. Two other studies in Kenya have also revealed that among road traffic injuries, passengers in public transport vehicles followed by pedestrians were most involved [24, 25]. These accidents could have occurred because of non-compliance with belt use or jaywalking (inappropriate road crossing) reported in our study.

Identification of demographic characteristics associated with NCD risk clusters and the injury risk clusters is essential for programming successful primary preventive measures. We therefore profiled the NCD and injury risk clusters to inform differentiated prevention and care services. The factors that stood out as independent predictors of NCD risk clusters were; age, gender, education, wealth and living arrangements. Hypertension, harmful use of alcohol or salt and tobacco smoking, and obesity increased with age while fat consumption reduced with age. Men were more likely to be hypertensive, harmful users and fat lovers, while women were more likely to be obese.

The common feature among these studies was the use of a multi-component scale to accurately define urbanicity even among villages considered to be rural and they found marked variation in levels of urbanicity across the villages, largely attributable to differences in economic activity, civil infrastructure, and availability of educational and healthcare services. Studies that loosely defined villages as urban or rural based on demarcation by national statistical bureaus as in this study have found no difference in NCD risk profiles among rural and urban populations, especially for hypertension [17, 18]. This suggests that even within rural populations social inequalities may exist which are often missed by the statistical bureaus because their classification of communities into rural and urban centers may not capture all the urbanicity scale components.

Regarding injuries, age, education and wealth improved compliant behaviors such as use of belts and helmets, and reduced defiant behaviors meaning as people get older or more educated or wealthier they become more responsible and tend to follow injury risk prevention measures. Education mediates comprehension of information such as written traffic rules or through an early exposure to a teaching curriculum in schools that includes traffic rules. It is worthwhile to mention that on the contrary jaywalking did not reduce with education, age, or wealth, but was instead seen to increase. A systematic review of literature on road traffic injuries in Kenya revealed that road traffic injuries have increased by four fold in three decades and up to 75% of the causalities are young adults aged 18–44 years, 80% of deaths are accounted for by pedestrians and passengers [25].

7 Predictors of the injury clusters

	Helmet users		Jaywalkers		The defiant		The compliant	
	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)
Age								
18–29 (reference)	1.00		1.00		1.00		1.00	
30–44	1.14	(0.96, 1.34)	1.22	(1.02, 1.46)	0.76	(0.65, 0.90)	0.92	(0.65, 1.30)
45–59	1.23	(1.00, 1.50)	1.25	(1.01, 1.56)	0.71	(0.58, 0.87)	0.79	(0.50, 1.23)
60–69	1.31	(1.01, 1.70)	1.19	(0.89, 1.61)	0.64	(0.50, 0.83)	1.23	(0.71, 2.15)
Sex								
Female (reference)	1.00		1.00		1.00		1.00	
Male	1.38	(1.20, 1.59)	0.93	(0.80, 1.09)	0.79	(0.68, 0.92)	0.89	(0.66, 1.21)
Marital Status								
Not in union (reference)	1.00		1.00		1.00		1.00	
In union	1.10	(0.93, 1.29)	0.94	(0.79, 1.12)	0.95	(0.81, 1.11)	1.02	(0.73, 1.42)
Residence								
Rural (reference)	1.00		1.00		1.00		1.00	
Urban	0.72	(0.62, 0.85)	0.95	(0.80, 1.12)	1.40	(1.19, 1.64)	1.14	(0.81, 1.61)
Education								
No schooling (reference)	1.00		1.00		1.00		1.00	
Primary incomplete	1.05	(0.84, 1.32)	2.11	(1.60, 2.79)	0.52	(0.42, 0.64)	2.97	(1.55, 5.69)
Primary complete	1.04	(0.82, 1.31)	2.32	(1.75, 3.07)	0.49	(0.39, 0.61)	2.68	(1.38, 5.20)
Secondary +	0.94	(0.73, 1.22)	2.51	(1.85, 3.39)	0.46	(0.36, 0.59)	3.75	(1.88, 7.47)
Employment								
Unemployed (reference)	1.00		1.00		1.00		1.00	
Employed	1.00	(0.86, 1.17)	0.98	(0.83, 1.15)	0.99	(0.85, 1.15)	1.13	(0.81, 1.58)
Wealth Index								
Poorest (reference)	1.00		1.00		1.00		1.00	
Second	0.93	(0.74, 1.17)	1.41	(1.09, 1.82)	0.79	(0.63, 0.98)	1.38	(0.82, 2.34)
Third	1.12	(0.89, 1.42)	1.25	(0.96, 1.62)	0.78	(0.62, 0.97)	1.01	(0.57, 1.76)
Fourth	1.24	(0.97, 1.59)	1.31	(0.99, 1.73)	0.67	(0.53, 0.85)	1.06	(0.59, 1.88)
Richest	1.59	(1.20, 2.11)	1.52	(1.12, 2.06)	0.43	(0.32, 0.56)	1.28	(0.69, 2.36)
Adults in household								
One (reference	1.00		1.00		1.00		1.00	
Two	0.97	(0.83, 1.14)	1.10	(0.93, 1.31)	1.01	(0.86, 1.18)	0.76	(0.54, 1.06)
Three or more	0.98	(0.80, 1.21)	1.03	(0.83, 1.29)	1.01	(0.83, 1.24)	0.92	(0.60, 1.40)
Constant	0.36	(0.29, 0.47)	0.12	(0.09, 0.16)	1.69	(1.34, 2.14)	0.02	(0.01, 0.04)

The traffic rules and enforcement seem to pay little attention to pedestrians. Most times the pedestrians break traffic rules and are not apprehended but instead treated as the victim of accidents. Public awareness about road safety especially for passengers and pedestrians is limited, thus the high risk of injuries among these groups.

The findings of this study have important implication for policy, practice and research. The identified clusters can guide where NCD policies and strategies need to focus. The resulting clusters would also be useful in the planning, implementation and evaluation of segmented approach to the prevention and control of NCDs. Similarly, future research projects could use these clusters to further explore the various characteristics associated with NCD profiles of the population of Kenya.

Strengths and limitations

A major strength of this paper is the large sample size representative of the Kenyan population and this has provided an opportunity to investigate NCD and injury risk factors at national level. Secondly, the cluster analytical approach used in this paper identified important

clusters of adult Kenyans with specific NCD and injury risk profiles for potential development of differentiated population-based interventions. However the main limitation of this cluster analytical approach is that it does not take into consideration the concurrency of risk factors, thus excludes important messages for those with multiple risk factors. Self-reported behavioural risk factors such as dietary intake and harmful use of alcohol are prone to bias, as participants may not accurately estimate quantities consumed or could purposefully conceal information for social desirability. We also excluded from the analysis individuals with incomplete records with respect to the key NCD and injury variables, which may have affected our analysis approach.

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In conclusion, this nationally representative survey reveals interesting patterns of NCD and injury risk clusters generated through K-medians cluster analysis which is a popular form of cluster analysis due to its simplicity of implementation, ability to partition large data sets, and ease in interpretation of its cluster solution and tolerance of outliers [32, 33]. This analysis has provided a holistic view of patterns of risk at population level for decision-makers to target populations with appropriate interventions. The main population groups to be prioritized for targeted NCD prevention interventions include; those with unhealthy diet (young fat lovers), the obese and hypertensive (older, wealthy and educated, men) and harmful users of alcohol, salt and tobacco (unmarried, older, living alone). When designing NCD preventive interventions rural populations should also be considered. Since Kenya is in the early stage of epidemiological transition, there is a window of opportunity to implement primordial NCD prevention measures to curtail the growing NCD epidemic. There is need for a multi-sectoral action to strengthen policies and implementation of programs with a focus on tackling unhealthy diet, prevention and management of hypertension and obesity. Strengthening the existing policies for tobacco and alcohol control to further reduce the current frequency of consumption and the experiences of developing these policies should inform the design of robust nutrition policies.

For injuries, there is need to design targeted messaging for road safety measures particularly for young, poor and uneducated people. Clear guidelines on safety measures for pedestrians and general public awareness on traffic guidelines for pedestrians are needed. Lastly, enhanced enforcement of traffic laws for pedestrians and passengers in public transport will be crucial in reducing road traffic injuries.

Abbreviations

ADCA: Alcoholic Drinks Control Act; APHRC: African Population and Health Research Center; CVD: Cardiovascualr diseases; MoH: Ministry of Health, Kenya; NASSEP V: National sample surveys and evaluation programme; NCD: Non-communicable diseases; PDA: Personal digital assistant; SSA: Sub-Saharan Africa; STEPS: The WHO STEPwise approach to Surveillance of non-communicable diseases; WHO: World Health Organization

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