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Awareness and Behavioural Risk Factors of Non-Communicable Diseases among Adults in the Kintampo North Municipality, Ghana: A Community-Based Cross-Sectional Study

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***Abstract*—Background Non-communicable diseases (NCDs) constitute a growing and largely preventable public health burden in sub-Saharan Africa, driven by modifiable behavioural risk factors including physical inactivity, unhealthy dietary practices, and tobacco use. In Ghana, these conditions account for an increasing share of morbidity, mortality, and healthcare expenditure, yet population-level awareness and risk factor data remain sparse for many district settings outside major urban centres. This study assessed the level of NCD awareness and the prevalence of key behavioural risk factors among adult residents of the Kintampo North Municipality in the Bono East Region of Ghana.**

Methods

A quantitative, community-based cross-sectional design was employed. A total of 428 adult residents were recruited across three communities, Kintampo, Babatorkuma, and Busuama using multistage simple random sampling. Data were collected using a structured, interviewer-administered guide incorporating validated instruments: the WHO Global Physical Activity Questionnaire (GPAQ) for physical activity assessment, and WHO-standardized items for dietary practices and tobacco use. Awareness of NCDs was assessed using a composite score derived from eight items. An NCD risk profile score was computed for each participant from the behavioural data. Chi-square tests of association (χ^2) examined relationships between each risk factor and the overall NCD risk profile. Data were analyzed using Epi Info Version 7.

Results

The sample was predominantly young (67.29% aged 18–41 years), male (71.03%), and had at least basic or secondary education (80.85%). NCD awareness was moderate: 42.76% of respondents demonstrated moderate knowledge and 21.50% high awareness, while 35.74% had low awareness. Awareness was significantly associated with NCD risk profile (χ^2 = 110.66, df = 4, $p < 0.001$), with low-awareness respondents showing the highest proportion of high-risk profiles (32.03%) compared with 3.26% among high-awareness respondents. More than half of respondents (52.34%) reported high physical activity levels, largely attributable to occupational and transport-related activity; however, 21.26% were classified as physically inactive. Physical activity was significantly associated with NCD risk profile (χ^2 = 55.30, df = 4, $p < 0.001$). Unhealthy dietary practices were prevalent among 50.47% of respondents and significantly associated with NCD risk (χ^2 = 25.24, df = 2, $p < 0.001$). Current tobacco use was reported by 31.78% of respondents and demonstrated the strongest association with high NCD risk profile (χ^2 = 225.56, df = 2, $p < 0.001$), with 56.62% of tobacco users classified in the high-risk category.

Conclusions

Adult residents of Kintampo North Municipality face a substantial and multifactorial NCD risk burden, driven by a critical gap between moderate disease awareness and the translation of that awareness into health-protective behaviour, particularly with respect to dietary practices and tobacco cessation. All four behavioural risk factors examined were significantly associated with NCD risk profiles. Intensified, community-embedded health education interventions, tobacco control enforcement, nutrition promotion programmes, and supportive environments for active lifestyles are urgently required in this and comparable Ghanaian district settings..

***Index Terms*—non-communicable diseases; NCD awareness; physical inactivity; dietary practices; tobacco use; NCD risk profile; Health Belief Model; Kintampo North; Ghana; sub-Saharan Africa**

I. BACKGROUND

Non-communicable diseases (NCDs), principally cardiovascular diseases, cancers, chronic respiratory diseases, and diabetes mellitus are chronic, non-transmissible conditions resulting from the interaction of genetic, physiological, environmental, and behavioural factors (Pan American Health Organization [PAHO], 2022). Globally, NCDs account for approximately 74% of all deaths annually, representing the leading cause of mortality worldwide (World Health Organization [WHO], 2021). In 2019, NCDs were responsible for an estimated 41 million deaths globally, of which over 15 million were premature deaths among adults aged 30–69 years, the majority occurring in low- and middle-income countries (LMICs) (WHO, 2021; Roth et al., 2020). The epidemiological significance of NCDs is compounded by their strong association with four modifiable behavioural risk factors including tobacco use, physical inactivity, unhealthy diet, and

harmful use of alcohol which mediate the majority of preventable NCD morbidity and mortality (GBD Risk Factors Collaborators, 2020).

In sub-Saharan Africa, the NCD burden is escalating at a pace that outstrips health system capacity, creating a dual burden of communicable and non-communicable disease that severely strains already resource-constrained health systems (Bigna & Noubiap, 2019). Rapid urbanization, changing dietary patterns driven by the nutrition transition, declining physical activity associated with sedentary occupations and motorized transport, and rising tobacco use are collectively accelerating NCD incidence across the region (Popkin et al., 2020; Afshin et al., 2019). Despite this growing burden, awareness of NCD risk factors and prevention strategies remains critically low across much of sub-Saharan Africa, with systematic reviews and multi-country surveys consistently reporting awareness levels of 25–40% for major conditions including hypertension and diabetes far below the levels required to drive meaningful population-level behaviour change (Bigna & Noubiap, 2019; Ataklte et al., 2019; WHO, 2023).

In Ghana, NCDs are a major and growing public health concern. Cardiovascular diseases, cancers, diabetes, and chronic respiratory conditions collectively account for an increasing proportion of hospital admissions, outpatient consultations, and deaths (Ministry of Health [MOH], 2022). The 2023 Ghana STEPS Survey revealed persistent geographic disparities in NCD risk factor prevalence and awareness, with lower-income and peri-urban districts including many in the Bono East Region demonstrating significantly lower awareness and higher behavioural risk exposure than major urban centres (MOH & Ghana Health Service [GHS], 2023). Ghana's National Policy for the Prevention and Control of Non-Communicable Diseases (MOH, 2022) prioritizes early detection and lifestyle modification as its primary prevention strategies, yet the absence of district-level baseline data on awareness and risk factor prevalence in settings such as Kintampo North Municipality fundamentally impedes the design of appropriately targeted and contextually grounded interventions.

The Kintampo North Municipality in the Bono East Region of Ghana reflects the broader national trend of increasing NCD burden set against persisting gaps in health literacy and preventive health behaviour. Health facility records from the Kintampo Municipal Hospital indicate a rising incidence of NCD-related consultations and admissions, yet no community-based epidemiological assessment of NCD awareness and modifiable risk factor prevalence had previously been conducted among the adult general population of this municipality. This study was therefore designed to fill that evidence gap, generating the first locally grounded, community-based quantitative profile of NCD awareness and key behavioural risk factors such as physical inactivity, unhealthy dietary practices, and tobacco use among adult residents of Kintampo North Municipality, with the aim of providing an empirical foundation for targeted public health intervention.

II. METHODS

Study design

A quantitative cross-sectional survey design was employed. This design was selected for its capacity to assess the prevalence of multiple variables simultaneously in a large and geographically dispersed population, its practical efficiency in terms of time and resource requirements, and its appropriateness for generating baseline epidemiological estimates upon which longitudinal or intervention studies can be built (Zangirolami-Raimundo et al., 2018; Babbie, 2005). The cross-sectional design is acknowledged to be unable to establish temporality or causality between exposure and outcome variables; findings are therefore presented as associations rather than causal relationships.

Theoretical framework

The study was framed within the Health Belief Model (HBM), originally developed in the 1950s by Rosenstock, Hochbaum, Kegeles, and Leventhal to explain and predict health-related behaviour (Jones et al., 2015). The HBM posits that health behaviour is determined by six core constructs: perceived susceptibility (individual assessment of risk of developing a condition), perceived severity (belief about the seriousness of consequences), perceived benefits (belief in the effectiveness of a recommended health action), perceived barriers (anticipated obstacles to taking that action), cues to action (internal or external triggers for health behaviour), and self-efficacy (confidence in one's ability to execute the recommended behaviour) (Yue et al., 2020). In this study, the HBM was applied to examine how awareness of NCDs as a proxy for perceived susceptibility and severity relates to the adoption of protective health behaviours and the modifiable risk factors that constitute the NCD risk profile. The framework guided the operationalization of study variables and the interpretation of associations between awareness levels and behavioural outcomes.

Study setting

The study was conducted in the Kintampo North Municipality, one of the administrative districts within the Bono East Region of Ghana. The municipality covers approximately 5,108 km^2 and, according to the 2021 Population and Housing Census, has a total population of 139,508, with a near-equal sex distribution (females 50.17%; males 49.83%). The municipality contains both rural, semi-urban, and urban settlements, providing a geographically diverse setting for community-based research. Healthcare is delivered through a tiered system anchored by the Kintampo Municipal Hospital and supported by health centres, Community-based Health Planning and Services (CHPS) compounds, and private facilities. The municipality is also the location of the Kintampo Health Research Centre, a nationally recognized health research institution that has contributed significantly to the evidence base on child health and infectious disease in the Ghanaian middle belt.

Study population, sampling, and sample size

The study population comprised all adults aged 18 years and above who were permanent residents of the Kintampo North Municipality and who had resided in the municipality for at least six months prior to data collection. Individuals who were severely ill, or who had severe cognitive or communicative impairments, were excluded. A multistage simple random sampling technique was used to select participants. In the first stage, a list of all communities in the municipality was compiled as the sampling frame, and three communities, Kintampo, Babatorkuma, and Busuama were selected by simple lottery random sampling from this list. In the second stage, households within each selected community were identified using house numbers as the sampling frame and randomly selected by lottery to meet the required community-level sample allocation. In the third stage, when a household contained more than one eligible adult, a single lottery draw was used to select one participant per household, eliminating researcher selection bias.

Sample size was calculated using Cochran's (1977) formula for large populations: $n = Z^2pq/e^2$, where $Z = 1.96$ (95% confidence level), $p = 0.50$ (estimated proportion; used to maximize sample size given no prior local prevalence estimate), and $e = 0.05$ (5% margin of error), yielding a minimum sample of 384. A 10% non-response adjustment was applied, producing a final minimum sample of 423. The study enrolled 428 participants, slightly exceeding this target and enhancing statistical precision.

Data collection instrument and procedure

Data were collected using a structured, interviewer-administered guide developed in English by the research team and adapted from validated international instruments. Section A collected seven socio-demographic items (age, sex, marital status, educational level, occupation, religion, and area of residence). Section B assessed NCD awareness using five items, with a composite awareness score computed from eight scored items to classify respondents as having low, moderate, or high NCD awareness. Section C assessed physical activity levels using eighteen items adapted from the WHO Global Physical Activity Questionnaire (GPAQ), a validated, standardized instrument designed for surveillance in diverse population settings that captures vigorous and moderate work-related, transport-related, and recreational physical activity, as well as sedentary time. Respondents were classified as having low, moderate, or high physical activity according to WHO guidelines. Section D evaluated dietary practices using items assessing frequency of fruit and vegetable consumption, intake of fried foods, sugary beverages, and extra salt, and processed food consumption; a dietary risk index of up to 23 points was computed and used to classify respondents as maintaining healthy or unhealthy dietary practices. Section E assessed tobacco use status (never-user, former user, current user) and the type and frequency of tobacco product use.

The instrument underwent expert review by senior public health researchers for content validity and was pilot-tested with ten participants outside the study communities, resulting in minor refinements to question wording and sequencing. Data were collected by four trained researchers who had completed a comprehensive Research Methods course, ensuring standardized administration, the ability to assist participants with limited literacy, and consistent application of

the interview protocol. Informed written consent was obtained from all participants prior to data collection.

Data analysis

Data were entered and analyzed using Epi Info Version 7. Check codes, legal value ranges, and range checks were implemented during data entry to maintain integrity. Descriptive statistics such as frequencies and proportions were used to characterize the socio-demographic profile of the sample and to summarize the distribution of awareness levels, physical activity categories, dietary patterns, tobacco use status, and NCD risk profile categories. Chi-square tests of independence (χ^2) were conducted to assess the statistical significance of associations between each of the four independent variables (NCD awareness, physical activity, dietary practices, and tobacco use) and the dependent variable (NCD risk profile). Effect sizes were interpreted in the context of the chi-square statistics and degrees of freedom. A two-tailed p-value of < 0.05 was adopted as the threshold for statistical significance throughout.

Ethical considerations

Data access approval was granted by the Kintampo Municipal Hospital. Prior to each interview, participants received a comprehensive briefing explaining the purpose of the study, the voluntary nature of their participation, and their right to withdraw at any time without penalty. Written informed consent was obtained from all participants. All data were handled to prevent individual identification: no names or personal identifiers were recorded on interview guides, and data were stored securely with access restricted to the research team. The study was conducted in accordance with the ethical standards of the Public Health Act, 2012 (Act 851) of Ghana and with the principles of the Declaration of Helsinki.

III. RESULTS

Socio-demographic characteristics

A total of 428 adults participated in the study. The majority (67.29%) were aged 18–41 years, reflecting the predominantly young demographic structure of the municipality. Males constituted 71.03% of the sample compared with 28.97% females. Educational attainment was predominantly at the basic (42.06%) or secondary (38.79%) level, while 19.16% had no formal education. More than half of respondents (52.80%) were single. Christianity was the dominant religion (83.18%). Respondents were distributed across urban (34.81%), semi-urban (33.41%), and rural (31.78%) areas, providing reasonable geographic coverage of the municipality's settlement typology.

Table 1: Socio-demographic characteristics of respondents (n = 428)

Characteristic	n	Percentage (%)
Age group (years)		

18–41	288	67.29
42–60	96	22.43
≥61	44	10.28
Sex		
Male	304	71.03
Female	124	28.97
Education level		
None	82	19.16
Basic/Primary	180	42.06
Secondary	166	38.79
Marital status		
Single	226	52.80
Married/Partnered	202	47.20
Area of residence		
Urban	149	34.81
Semi-urban	143	33.41
Rural	136	31.78
Religion		
Christianity	356	83.18
Islam / Other	72	16.82

Awareness of NCDs and association with NCD risk profile

NCD awareness was distributed across three levels: 35.74% of respondents demonstrated low awareness, 42.76% moderate awareness, and 21.50% high awareness of non-communicable diseases, their risk factors, and prevention strategies. The association between awareness level and NCD risk profile was highly statistically significant ($\chi^2 = 110.66$, df = 4, $p < 0.001$). Among respondents with low NCD awareness, 32.03% fell within the high-risk NCD profile category, compared with only 3.26% of those with high awareness. Conversely, respondents with high awareness demonstrated a substantially higher proportion classified in the low-risk profile

category. This inverse gradient between awareness and risk profile was consistent and monotonic, confirming that higher awareness is associated with meaningfully lower behavioural NCD risk exposure.

Table 2: Association between NCD awareness levels and NCD risk profile ($\chi^2 = 110.66$, df = 4, $p < 0.001$)

Awareness Level	Low Risk	Moderate Risk	High Risk	Total (%)
Low awareness	—	—	32.03%	35.74%
Moderate awareness	—	—	~14%	42.76%
High awareness	—	—	3.26%	21.50%
$\chi^2 = 110.66$; df = 4; $p < 0.001$				

Physical activity levels and association with NCD risk profile

Physical activity assessment using the WHO GPAQ revealed that 52.34% of respondents were classified as having high physical activity levels, 26.40% moderate, and 21.26% low. The high proportion of respondents meeting or exceeding physical activity recommendations reflects the predominance of occupationally and transport-related physical activity in this semi-urban and rural setting, where manual agricultural work, construction, and walking as the primary mode of transport constitute a major component of daily energy expenditure. Despite this overall pattern, over one in five respondents was classified as physically inactive, a proportion that carries substantial population-level risk. The association between physical activity level and NCD risk profile was highly significant ($\chi^2 = 55.30$, df = 4, $p < 0.001$), with respondents classified as physically inactive demonstrating higher proportions of moderate and high NCD risk profiles compared with those with high activity levels.

Table 3: Levels of Physical activity Among Respondents

Level of Physical Activity	No.	%	95%Cl
Low	91	21.26	17.65-25.38
Moderate	113	26.40	22.45-30.77
High	224	52.34	47.60-57.03
Total	428	100	

Dietary practices and association with NCD risk profile

Dietary assessment revealed an almost equal split between healthy and unhealthy dietary patterns in the study population: 50.47% of respondents were classified as maintaining unhealthy dietary practices and 49.53% as maintaining healthy practices. The proximity of this split to 50:50 underscores the magnitude of the dietary risk burden in this community with roughly half the adult population engaged in dietary behaviour patterns characterized by insufficient fruit and vegetable

consumption and/or excessive intake of fried foods, refined sugars, or extra salt. The association between dietary pattern and NCD risk profile was statistically significant ($\chi^2 = 25.24$, df = 2, $p < 0.001$), with respondents practicing unhealthy diets more likely to fall within the moderate and high NCD risk profile categories compared with those maintaining healthy dietary practices.

Table 4: Association between Dietary Patterns and NCD Risk Profile of Participants.

	NCD Risk Profile					
Dietary Patterns	Low		Moderate		High	
	No.	%	No.	%	No.	%
Healthy diet	95	44.81	78	36.79	39	18.40
Unhealthy diet	50	23.15	126	58.33	40	18.52
Total	145	33.88	204	47.66	79	18.46

X^2=25.24, df=2, p<.001

Tobacco use and association with NCD risk profile

The majority of respondents (66.36%) had never used tobacco, while 31.78% were current tobacco users and 2.74% former users. The current tobacco use prevalence of 31.78% is substantially higher than the 22.3% global adult prevalence reported by WHO (2021) and the approximately 15–20% prevalence typically observed in southern Ghanaian urban settings, suggesting that tobacco use represents a particularly elevated and under-addressed risk factor in the Kintampo North Municipality. Tobacco use demonstrated the strongest and most consistent association with NCD risk profile of all variables examined ($\chi^2 = 225.56$, df = 2, $p < 0.001$). Among current tobacco users, 56.62% were classified in the high NCD risk profile category, the highest proportion of any risk-stratified subgroup in the study compared with a much lower proportion among non-users, who predominantly fell within low and moderate risk categories.

Table 5: Association between Tobacco Use Status and the Risk Profile of Respondents.

	NCD Risk Profile					
Tobacco use status	Low		Moderate		High	
	No.	%	No.	%	No.	%
User	0	0	59	43.38	77	56.62
Non-user	145	49.66	145	49.66	2	0.68
Total	145	33.88	204	47.66	79	18.46

X^2=225.56, df=2, p<.001

IV. DISCUSSION

This study provides the first community-based, quantitative assessment of NCD awareness and behavioural risk factor prevalence among adult residents of the Kintampo North Municipality, a district-level setting in the Bono East Region of Ghana that has been largely absent from the

published NCD epidemiological literature. The findings reveal a population facing a substantial and multifactorial NCD risk burden driven by the convergence of four independently significant behavioural determinants: moderate but insufficient NCD awareness, a noteworthy prevalence of physical inactivity, near-equal prevalence of healthy and unhealthy dietary practices, and an elevated current tobacco use prevalence. The triangulation of these findings within the Health Belief Model framework illuminates the critical gap between perceived risk and protective health action that defines the NCD challenge in this setting.

NCD awareness and the awareness-behaviour gap

The finding that 42.76% of respondents demonstrated moderate NCD awareness and 21.50% high awareness, while 35.74% remained in the low-awareness category, aligns with the pattern of moderate but insufficient public health literacy documented across Ghana and sub-Saharan Africa more broadly. Kushitor et al. (2024) reported consistently low-to-moderate NCD awareness in Ghanaian community settings, finding that inadequate awareness contributes to poor preventive practices and delayed diagnosis. Owusu et al. (2023) found that only 28% of Ghanaian community respondents demonstrated high NCD awareness, while Gyamfi et al. (2022) reported that only 35% of participants in a rural Ghanaian setting exhibited good NCD knowledge. Bigna and Noubiap (2019), in their systematic review across sub-Saharan Africa, documented awareness levels of only 25–35% for major NCD conditions including hypertension and diabetes — a finding convergent with the proportion of low-awareness respondents in this study.

The highly significant inverse association observed between awareness and NCD risk profile ($\chi^2 = 110.66$, $p < 0.001$) with 32.03% of low-awareness respondents in the high-risk category compared with only 3.26% of high-awareness respondents confirms that awareness is a meaningful protective factor at the population level. This is consistent with findings by Zhang et al. (2022), whose systematic review demonstrated that awareness interventions significantly reduce exposure to modifiable NCD risk factors, and with Wekesah et al. (2018), who documented measurable reductions in risk behaviours following community-based health education in Kenya. However, the persistence of unhealthy behaviours even among respondents with moderate awareness in this study particularly regarding dietary practices and tobacco use reflects what the literature describes as the awareness-behaviour gap: the well-documented divergence between knowledge of health risks and the sustained adoption of risk-reducing behaviour (Nutbeam & Lloyd, 2021; Mohammed et al., 2022). The HBM constructs of perceived barriers and self-efficacy help explain this gap: respondents may understand that tobacco use and poor diet increase NCD risk, yet face structural barriers including food cost, social norms around tobacco, and limited access to healthy food options that override their intention to change behaviour.

Physical activity patterns

The finding that 52.34% of respondents reported high physical activity levels, despite a significant association with NCD risk among the 21.26% classified as inactive, requires careful contextual

interpretation. In the Kintampo North setting, the high aggregate physical activity prevalence is primarily attributable to occupational and transport-related physical activity manual agricultural work, construction, and walking as the dominant mode of transport rather than to intentional leisure-time physical exercise, which typically represents only a small fraction of the total activity pattern (Aryeetey et al., 2018; Boateng et al., 2026). This distinction has important implications for programme design: the high levels of occupational activity, while conferring current cardiovascular benefit, are inherently vulnerable to displacement as urbanization, technological penetration, and economic transition reduce manual labour demands. Strain et al. (2024), in a pooled global analysis of 5.7 million participants, documented a concerning upward trend in global physical inactivity from 23.4% in 2000 to 31.3% in 2022, with projections suggesting further increases. In Ghana specifically, Mogre et al. (2019) found that 28% of adults were physically inactive and Mensah et al. (2022) documented that nearly half of Ghanaian adults fail to meet international physical activity guidelines. The current study's 21.26% prevalence of physical inactivity occurring in a largely non-urban setting where occupational activity remains high suggests that the true prevalence of leisure-time inactivity is substantially higher, and that the trajectory of overall inactivity in this municipality may mirror the unfavourable national and global trends as occupational structures shift.

Dietary practices

The 50.47% prevalence of unhealthy dietary practices in this community-based sample with a statistically significant association with NCD risk profile ($\chi^2 = 25.24$, $p < 0.001$) is consistent with and contextualized by a substantial body of literature on dietary transitions in Ghana and sub-Saharan Africa. Osei-Kwasi et al. (2020) found that over 60% of Ghanaian participants consumed fried or processed foods at least three times weekly, while only 27% met the recommended intake of fruits and vegetables. Laar et al. (2020) documented that over 70% of Ghanaian adults exceeded the WHO recommended daily salt intake, with a strong association with hypertension prevalence. Bosu et al. (2020) found that approximately 63% of Ghanaian adults regularly consumed meals high in saturated fats and salt. Amoah et al. (2022) reported that 58% of Ghanaian adults regularly consumed sugary beverages and processed foods more than three times weekly. The near-equal split between healthy and unhealthy dietary practices observed in this study while more balanced than some of the above estimates nonetheless represents a significant population-level risk, particularly given the progressive dietary transition underway as market foods, processed snacks, and sugary beverages become more accessible even in semi-urban and rural districts. Afshin et al. (2019), in the Global Burden of Disease dietary risk analysis, identified poor diet as responsible for approximately 11 million deaths globally, with high sodium intake, low fruit consumption, and low vegetable consumption among the leading specific risk factors. The findings from this study reinforce the urgency of nutrition promotion interventions that are specifically designed for the dietary context of the Kintampo North Municipality.

Tobacco use

The current tobacco use prevalence of 31.78%, and its exceptionally strong association with high NCD risk profile ($\chi^2 = 225.56$, $p < 0.001$; 56.62% of tobacco users in the high-risk category), represents arguably the most actionable finding of this study. This prevalence substantially exceeds the WHO-reported global adult tobacco use prevalence of approximately 22.3% (WHO, 2021) and is above national Ghanaian estimates, which typically range from 7% to 15% across adult populations. The elevated prevalence in the Kintampo North setting is consistent with observations from comparable West and Central African contexts: Adebayo et al. (2023) found that 25% of men in their sample used tobacco, with a notably higher rural prevalence; Mensah et al. (2024) reported approximately 30% adult tobacco use in several African countries; and Ameh et al. (2019) documented tobacco use in approximately 29% of adult males in sub-Saharan Africa. The near-exclusive male predominance of tobacco use (71% of the total sample was male) likely partly explains the elevated prevalence, as tobacco use rates in Ghana and sub-Saharan Africa are consistently and substantially higher among men than women (WHO, 2022). Tobacco use has been identified as the single most important modifiable risk factor for cardiovascular diseases, multiple cancers, and chronic obstructive pulmonary disease globally (GBD Risk Factors Collaborators, 2020; Reitsma et al., 2021). The extraordinarily high proportion of tobacco users in the high NCD risk profile category (56.62%) in this study driven by the compound interaction of tobacco use with other behavioural risk factors in the same individuals underscores the public health primacy of tobacco control in this municipality.

Strengths and limitations

This study contributes the first community-based, cross-sectional estimate of NCD awareness and behavioural risk factor prevalence from the Kintampo North Municipality, filling a documented evidence gap in the Ghanaian district-level NCD literature. Key methodological strengths include the use of validated instruments (WHO GPAQ; WHO-standardized dietary and tobacco items), the multistage random sampling design that minimized selection bias and enhanced geographic representativeness across urban, semi-urban, and rural settings, and the use of trained interviewers who mitigated non-response and literacy-related barriers to self-report data quality. The sample of 428 participants exceeding the minimum required provided adequate statistical power for all four chi-square analyses.

Several limitations merit acknowledgement. First, the cross-sectional design captures associations at a single time point and cannot establish temporal precedence or causal relationships between awareness, risk factors, and NCD outcomes. Second, self-reported data on behavioural exposures are susceptible to social desirability bias, particularly for tobacco use (likely underreported) and physical activity (likely overreported), potentially leading to underestimation of true risk factor prevalence. Third, the absence of clinical measurements blood pressure, fasting blood glucose, lipid profile, body mass index — means that NCD outcomes were estimated from behavioural risk proxy measures rather than directly assessed biological status. Fourth, restriction of the study to three communities within a single municipality limits the generalizability of findings to the broader

Bono East Region and to other Ghanaian districts. Future research should incorporate clinical biometric measurements alongside behavioural risk factor assessment, and should employ longitudinal designs to better understand the determinants of health behaviour change in this population.

V. CONCLUSIONS

This study demonstrates that adult residents of the Kintampo North Municipality carry a significant and multifactorial NCD risk burden, characterized by moderate but insufficient NCD awareness, a substantial prevalence of physical inactivity (21.26%), an approximately equal split between healthy and unhealthy dietary practices (50.47% unhealthy), and an elevated current tobacco use prevalence (31.78%). All four behavioural risk factors were significantly and independently associated with NCD risk profile (all $p < 0.001$). Tobacco use demonstrated the strongest association, with more than half of current tobacco users classified in the high NCD risk category. The critical finding of a significant awareness-risk gradient with low-awareness respondents exhibiting ten times the proportion of high-risk profiles compared with high-awareness respondents confirms that NCD awareness, while necessary, is insufficient on its own to drive protective health behaviour without simultaneous attention to the structural, environmental, and social determinants of behaviour.

These findings generate several evidence-based priorities for action. The Ghana Health Service, in partnership with the Kintampo North Municipal Health Directorate, should intensify community-based health education programmes delivered through community health workers, community durbars, and local radio that explicitly address NCD risk factors and their consequences in culturally resonant and practically actionable terms. Tobacco control enforcement, including the implementation of smoke-free environments, anti-tobacco messaging in schools, and accessible cessation services, is urgently needed given the disproportionate contribution of tobacco use to high NCD risk profiles in this community. Nutrition promotion programmes should be integrated into routine primary health care contacts and community outreach, with specific focus on increasing fruit and vegetable consumption and reducing processed food and salt intake. Physical activity-enabling environments including safe walking and recreational spaces, workplace wellness initiatives, and active transport policies should be developed with the Kintampo North Municipal Assembly as implementation is inherently a cross-sectoral responsibility. Finally, these findings provide a replicable methodological framework for generating district-level NCD baseline data across other Ghanaian municipalities, supporting the evidence-informed targeting of limited public health resources to the highest-need populations.

VI. LIST OF ABBREVIATIONS

CHPS: Community-based Health Planning and Services | GBD: Global Burden of Disease | GHS: Ghana Health Service | GPAQ: Global Physical Activity Questionnaire | HBM: Health Belief

Model | KHRC: Kintampo Health Research Centre | LMICs: Low- and Middle-Income Countries | MOH: Ministry of Health | NCD: Non-communicable Disease | PAHO: Pan American Health Organization | WHO: World Health Organization.

VII. DECLARATIONS

Ethics approval and consent to participate
Ethical approval was granted by the Academic Research Board of the College of Health and Well-Being, Kintampo, and data access approval was provided by the Kintampo Municipal Hospital. Written informed consent was obtained from all study participants prior to data collection. The study was conducted in accordance with the Public Health Act, 2012 (Act 851) of Ghana and the principles of the Declaration of Helsinki.
Consent for publication
Not applicable. No individual-level identifying data are included in this manuscript.
Availability of data and materials
The datasets generated and analyzed in this study are available from the corresponding author on reasonable request, subject to any applicable data governance constraints.
Competing interests
The authors declare that they have no competing interests.
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Authors' contributions
MK conceived the study, supervised the research design, data collection, and analysis, provided intellectual oversight throughout, and led the development of this manuscript. AHY, KJ, KS, NVK conducted the fieldwork, collected and entered the data, performed the initial analysis under supervision, and contributed to drafting the original project report from which this manuscript was developed and AA provided oversight in the data analysis and writeup of the manuscript. All authors reviewed and approved the final manuscript.

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