

# Contextual factors in premature non-communicable disease mortality in selected African countries within the sustainable development goals framework: the implication of voice and accountability

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## Abstract

Sustainable Development Goal number 3, target 4 (SDG 3.4), seeks a 30% reduction in premature Non-Communicable Diseases (NCDs) mortality from 2015 levels by 2030. Africa United Nations (UN) Member States continue to experience increasing NCD mortality significantly, with the highest proportion of diabetes mortality among the working-age group. Past efforts to address this burden have been centered primarily on individual risk modifications evident by the NCDs Cluster Program at the World Health Organization (WHO) Africa Regional Office. To achieve a progressive reduction, a comprehensive premature NCD reduction approach which includes a consideration of contexts within which premature NCD, such as diabetes mortality arises is necessary. The aim was to examine the relationship between contextual factors and diabetes-related deaths as premature NCD mortality and to enable an improved contextualized evidence-based approach to premature NCD mortality reduction. Country-level data was retrieved for post SDG initiative years (2016-2019) from multiple publicly available data sources for 32 selected Africa UN Member States in the International Diabetes Federation (IDF) East and West Africa Region. Multiple linear regression was employed to examine the relationship between diabetes-related deaths in individuals 20-79 years and contextual factors identified within the SDG framework. Weighted data analysis showed that voice and accountability as a contextual factor explained approximately 47% variability in

diabetes-related deaths across the selected Africa UN Member States in IDF East and West Region (n=32). Civil society engagement is vital to develop effective premature NCD mortality reduction policies, and strategies and stakeholders' accountabilities are necessary to ensure adherence to obligations.

## Introduction

The Sustainable Development Goals (SDGs) were goals set by the United Nations (UN) member states with specific targets to be achieved by 2030 for a better and sustainable future.<sup>1</sup> Significant in the SDGs is goal number 3 (SDG 3), which pertains to health to ensure healthy lives and promote well-being. SDG 3 has 13 targets, and included is a target to reduce by one-third the risk of death between 30-70 years inclusive from Non-Communicable Diseases (NCDs), specifically diabetes, cardiovascular diseases, cancer, and Chronic Respiratory Diseases (4NCD) through prevention and treatment and promote mental health and well-being, by 2030 (SDG 3.4).<sup>1</sup>

SDG 3.4 is of high importance globally, especially in Africa, because of the increasing number of deaths associated with 4NCD.<sup>1</sup> About 41 million people worldwide die from NCDs annually, and more than 85% of premature NCD deaths occur in low- and middle-income countries, primarily located in Africa.<sup>2</sup> Despite the adoption of SDG 3.4 since 2015, premature NCD mortality reduction is not progressive amongst the UN Member States in Africa. For example, small increases in premature NCD mortality are observed in Ghana, Côte d'Ivoire, and Kenya.<sup>3</sup> Moreover, Africa recorded the highest proportion of diabetes-related deaths in 2019, and the most affected are the working age-group.<sup>4</sup>

While infectious diseases are acute and rapidly responsive to interventions, NCDs are salient with long-term economic consequences, with etiological complexities.<sup>5</sup> For this reason, conscientious efforts in addressing this burden are necessary, which goes beyond modification of individual risks stated in previous guidelines,<sup>5</sup> to include a consideration of contextual factors for a preventive comprehensive NCD reduction approach. The contextual factors include inadequate universal health coverage within fragile health systems to provide quality NCD routine management services.<sup>6</sup> Other factors include resource constraints, misconceptions of NCDs as western world diseases, lack of political prioritization, evident with the non-inclusion of NCDs in the Africa Union Agenda 2063, poor gover-

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Availability of data and materials: All data generated or analyzed during this study are included in this published article.

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Informed consent: The manuscript does not contain any individual person's data in any form.

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nance, such as weak voice and accountability, and competing priorities.<sup>7,8</sup>

During the third High-Level Meeting (HLM), discussions held in September 2018 focused on NCDs as a public health priority. Still, the IDF identified the failure to address factors within which NCD occurs, such as lack of substantial political commitment.<sup>9</sup> The gap further emphasizes the need to consider contextual factors with the behavioral interventive approach outlined and implemented from previous guidelines. This action would enable policy action that addresses long-term social relations and systems that determine NCD distribution and their risk factors.<sup>5</sup> The consideration of contextual factors within the three pillars of sustainability: social, economic, and environment, would help estimate NCD population risk factors to accelerate preventive premature NCD mortality reductive measures. As such, this study sought to demonstrate the association of contextual factors and diabetes-related deaths to recommend inclusion in the comprehensive framework for premature NCD mortality reduction.

The social-ecology theory was employed to examine the association between contextual factors and diabetes mortality as an NCD. This model shows that premature NCD such as diabetes mortality does not occur in isolation but results from multiple factors, including intrapersonal and environmental factors.<sup>10</sup> The socio-ecology framework is frequently employed in public health to review the interaction between health outcomes and the environments, indicating the various levels of influence;<sup>11</sup> to enable the development of key policy actions and practical initiatives for NCDs reduction, by focusing on changes at various influence levels.<sup>11</sup> Moreover, the framework argues that an individual's health profile is an aggregate sum of factors that create the contexts in which health problems arise. Likewise, the opportunities and barriers to addressing health outcomes should consider such factors.<sup>12</sup>

Past studies like Caprio et al., 2008 established a relationship between health outcomes and the broader ecology surrounding individuals.<sup>13</sup> Similarly, Diez Roux, 2012, stated that the more general ecology in which health outcome arises includes contextual factors in social, environmental, and economic systems that embed individuals and associated behaviors.<sup>14</sup> Additionally, Jobson et al., 2014 demonstrated that integrating contextual factors into health interventions contributes to improved and sustainable health outcomes.<sup>15</sup> Based on these pieces of evidence, considering of contextual factors in preventive premature NCD mortality reduction is

vital along with other known risk factors to achieve in part SDG 3.4. This study employed relatable contextual factors within the SDGs framework within the sustainability pillars to examine their relationships with diabetes-related deaths, as shown in Figure 1.

This study is unique because, since the inception of the SDGs, no study has examined the association between contextual factors and diabetes-related deaths, as premature NCD mortality amongst UN Africa Member States, to provide transferable knowledge for all-inclusive contextualized NCD reduction interventions. Also, this study would strengthen regional data and re-evaluate NCD reduction initiatives recommended in the SDG Agenda principles for follow-up and review processes.<sup>1</sup>

## Materials and methods

This study examined the relationship between contextual factors in the social, economic, and environmental systems and diabetes-related deaths in individuals 20-79 years in 2019 as an example of premature NCD mortality, focusing on the UN Member States in the IDF Africa Region, to enable an effective and sustainable preventive comprehensive approach to reduce premature NCD mortality.

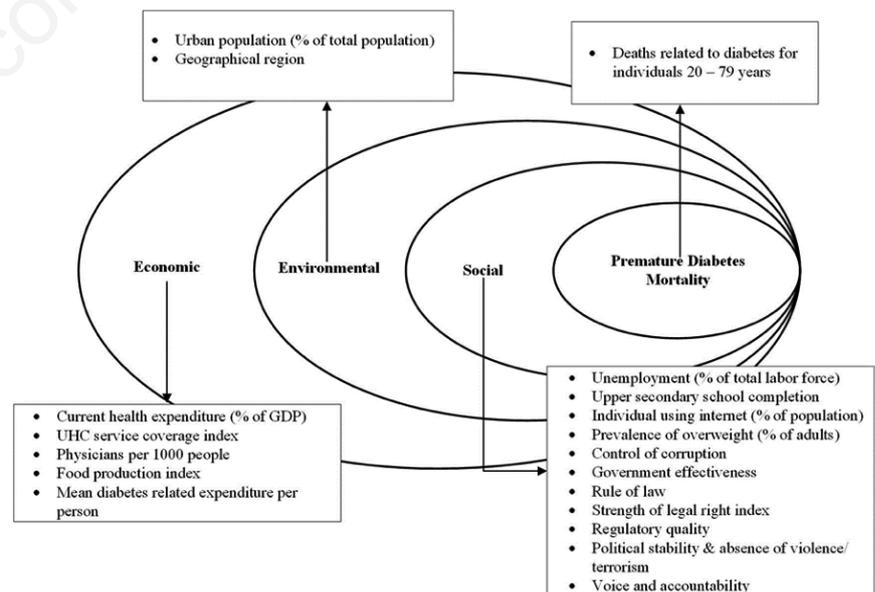
## Ethical considerations

This study was approved by the Central Michigan University Institutional Review Board (IRB), with a study approval of 020-680. The study was granted an "exempt from IRB review" according to section 45 CFR 46.104(d)2 (ii) of the revised Common Rule: Surveys, Interviews and Observations any disclosure outside the research would not place subject at risk.

## Study participants and sample size

32 UN Member States in IDF East and West Africa Region were included in the study, having similar disease profiles, exposure, and outcome data,<sup>16</sup> in the study. Conversely, the UN Member States in Middle Africa and Southern Africa were excluded from the study due to significant data gaps and distinct disease profiles in these regions. Likewise, the UN Member States in Northern Africa were excluded due to categorization as part of the UN and WHO's Eastern Mediterranean region.<sup>16</sup>

The UN Department for General Assembly and Conference Management affirmed 54 African countries as Members of the UN.<sup>17</sup> Additionally, the IDF Africa Region consists of 48 countries.<sup>18</sup> The UN Member States in IDF East Africa Region included in this study were Burundi, Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Malawi, Mauritius,



**Figure 1. Social-Ecological Model Adapted for the Association of Contextual Factors and Premature Diabetes Mortality. World Health Organization. The ecological framework. Available from: <https://www.who.int/violenceprevention/approach/ecology/en/>. [Accessed 3 February 2021].**

Mozambique, Rwanda, Seychelles, Somalia, Uganda, United Republic of Tanzania, Zambia, and Zimbabwe. While UN Member States in the IDF West Africa Region were Benin, Burkina Faso, Cape Verde, Cote d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo.

## Methodology

Country-level data were obtained from multiple publicly available data sources, including the IDF Atlas 2019 Edition, World Bank database (Environment, Social, and Governance; and Health, Nutrition, and Population Statistics), United Nations Educational, Scientific, and Cultural Organization (UNESCO)(World Inequality Database on Education), for the selected UN Africa Member States. Diabetes-related death for individuals 20-79 years were retrieved from the IDF 2019 Atlas. Similarly, the SDG framework was used to construct contextual factors in the social, economic, and environmental systems, with indicators identified in the databases mentioned above.

Within data availability constraints, calendar years allowed for a lag between contextual features from 2016 (predictors) and diabetes-related deaths in 2019 (outcome). The total number of contextual factors was 16: Social (10), Economic (4), and Environmental (2). Data from across sources were merged into a single Excel file to create a single dataset of countries, contextual factors, diabetes-related deaths, and a categorical variable for the geographical IDF Africa regions (East or West). This Excel file was then exported to an IBM SPSS statistical platform for statistical analysis to answer the following research questions and test the postulated hypotheses.

*Overreaching research question (ORQ):* What is the relationship between contextual factors and premature NCD such as diabetes-related deaths using the socio-ecological framework in selected African countries? How can an understanding of this association assist in an improved approach to achieve in part the SDG target 3.4?

Three investigative questions were asked to reflect the three pillars of sustainability as follows:

*Investigative research question 1 (IRQ1):* Is there a relationship between social contextual features (Unemployment, total (% of total labor force) (UNE), Upper Secondary School Completion (USC), Individuals using the Internet (% of population) (IUI), Prevalence of Overweight (% of adults) (POO), Control of Corruption:

Estimate (COC), Government Effectiveness (GOE), Rule of Law (ROL), Strength of Legal Rights Index (SLRI), Regulatory Quality (RQ), Political Stability and Absence of Violence/Terrorism (PSAVT), Voice and Accountability: Estimate (VA), and premature NCD mortality such as diabetes-related deaths in selected African countries?

*IRQ2:* Is there a relationship between economic contextual features (Current Health Expenditure (% of gross domestic product (GDP)) (CHE), Universal Health Service Coverage Index (UHC), Physicians (per 1,000 people) (PPP), Food Production Index (FPI), and premature NCD mortality such as diabetes-related deaths in selected African countries?

*IRQ3:* Is there a relationship between environmental contextual features (Urban population (% of total population) (URP), Geographical Region in Africa (REG)) and premature NCD mortality such as diabetes-related deaths in selected African countries?

A relative value for diabetes-related deaths was calculated as diabetes-related deaths divided by total population size multiplied by 1000. As defined in SDG 3.4, premature NCD mortality is the probability of dying between 30-70 years from 4NCD. Diabetes-related deaths in individuals 20-79 years per 1,000 people was considered an outcome variable in this study since most NCDs have similar etiological pathways, and diabetes serves as a risk factor for developing the other NCDs listed in SDG 3.4. For example, an increased risk of cancer are observed in individuals with type 2 diabetes and a high Body Mass Index (BMI). Similarly, there is a strong association between type 2 diabetes and cardiovascular diseases.<sup>19</sup> Therefore, these hypotheses were postulated using diabetes-related deaths in individuals 20-79 years to represent the premature mortality from the 4NCD:

*Hypothesis 1:* There is a relationship between UNE, USC, IUI, POO, COC, GOE, ROL, SLRI, RQ, PSAVT, VA, and diabetes-related deaths in individuals 20-79 years per 1,000 people in selected African countries.

*Hypothesis 2:* There is a relationship between CHE, UHC, PPP, FPI, MDEP, and diabetes-related deaths in individuals 20-79 years per 1,000 people in selected African countries.

*Hypothesis 3:* There is a relationship between URP, REG, and diabetes-related deaths per 1,000 people in selected African countries.

## Data analysis

The study hypotheses were tested with a multiple linear regression model that was

weighted, where the weight for each country was based on its population. The overall regression equation was:

$$DRD = \beta_0 + \beta_1*UNE + \beta_2*USC + \beta_3*IUI + \beta_4*POO + \beta_5*COC + \beta_6*GOE + \beta_7*ROL + \beta_8*SLRI + \beta_9*RQ + \beta_{10}*PSAVT + \beta_{11}*VA + \beta_{12}*CHE + \beta_{13}*UHC + \beta_{14}*PPP + \beta_{15}*FPI + \beta_{16}*MDEP + \beta_{17}*URP + \beta_{18}*REG$$

Based on the social-ecological theory, diabetes-related deaths result from multiple contextual factors such as those in the social, economic, and environmental systems, as shown in Figure 1, necessitating the importance of consideration of these factors and their interactions to enable a comprehensive approach to diabetes-related deaths reduction.

Past studies showed that socio-political factors such as good governance are associated with higher health systems' performance,<sup>20</sup> providing comprehensive routine NCD management services. Economic factors such as health financing mechanisms like universal health coverage play a significant role in healthcare access, contributing to health outcomes.<sup>20</sup> Environmental factors such as rapid urban population growth change the built environment in which people live, work, or play, thereby having a remarkable impact on their health outcomes.

Considering that multiple contextual factors could explain variability in diabetes-related deaths, the multiple linear regression was the appropriate statistical analysis for testing the hypotheses postulated in this study. Similarly, the multiple linear regression utilizes two or more predictor variables to predict a variable of interest,<sup>21,22</sup> and this study employed more than two contextual factors in explaining the variability in diabetes-related death in individuals 20-79 years per 1,000 people. More so, the multiple linear regression's thumb rules for sample size are at least 20 cases per independent variable in the analysis.<sup>22</sup> This study has more than 20 cases (32 cases) per independent variable.

## Results

In the analysis, when cases were weighed based on country size, diabetes-related deaths in individuals 20-79 years per 1,000 people were approximately normally distributed. An independent t-test conducted to compare IDF Africa East, and West Regions showed no statistically significant difference.

A bivariate analysis utilizing correla-

tions showed that diabetes-related deaths in individuals 20-79 years per 1,000 and UNE showed a significant positive correlation at  $r=0.562$ ,  $p=0.001$ . Similarly, diabetes-related deaths in individuals 20-79 years per 1,000 and IUI seemed to be approaching a significant positive correlation at  $r=-0.337$ ,  $p=0.059$ , while diabetes-related deaths in individuals 20-79 years per 1,000 and VA appeared to be approaching a significant negative correlation at  $r=-0.337$ ,  $p=0.072$ . Also, there was a significant positive correlation between diabetes-related deaths in individuals 20-79 years per 1,000 and PPP, at  $r=0.471$ ,  $p=0.011$ . Furthermore, a significant positive correlation is observed between diabetes-related deaths in individuals 20-79 years per 1,000 and MDEP, at  $r=0.398$ ,  $p=0.026$ . Nevertheless, MDEP was excluded not to trigger multicollinearity in the model as this independent variable was highly correlated with UNE ( $r=0.079$ ,  $p=0.0000$ ). Hence, the final model had four predictors included in the multiple linear regression model, and the equation is as follows:

$$DRD = \beta_0 + \beta_1 * PPP + \beta_2 * VA + \beta_3 * IUI + \beta_4 * UNE$$

The outcome or dependent variable is diabetes-related deaths in individuals 20-79 years per 1,000 people, and the predictors or independent variables are PPP, VA, IUI, and

UNE. Table 1 depicts the model summary.

The overall model has an R-square adjusted value of 0.47, which suggests that the model can describe 47% of the variability in diabetes-related deaths in individuals 20-79 years per 1,000 people with PPP, VA, IUI, and UNE as predictors. The ANOVA Table 2 showed that the model overall is statistically significant,  $F(4,18)=5.97$ ,  $p=0.003$ .

Only VA was statistically significant with a negative coefficient (-0.062), indicating that a higher level of accountability (one additional unit on a -2.5 to 2.5 scale) is associated with fewer diabetes-related deaths in individuals 20-79 years per 1,000 people holding other factors constant (Table 3). The reduction in diabetes-related deaths in individuals 20-79 years is 0.062 per 1,000 with a 95% confidence interval (CI) between (0.020 to 0.104).

**Assumption Checks:** The suitability of the multiple linear regression model was checked as follows:

**Multicollinearity:** The variance inflation factor (VIF) value was 4.084, which is less than 5. As such, there was no multicollinearity between PPP, VA, IUI, and UNE.

**Checking for outliers:** There are no outliers as all standardized residuals are within  $\pm 3$  (range is from -1.437 to 2.662). Additionally, checking for outliers, the residuals (errors) are approximately nor-

mally distributed, as observed with an approximately bell-shaped histogram confirming another model assumption of normality of residuals. Furthermore, the P-P plot constructed suggested the data is approximately normal, with a potentially slight deviation from normality in the middle of the distribution.

**Homoskedasticity:** There are a couple of observations on the right side that appear to have low variability than the rest of the graph, but overall, it seems the homoskedasticity assumption was met.

**Durbin-Watson:** Durbin-Watson statistics was not reported for this model.

## Limitations

The SDGs initiative is relatively new, preventing a longitudinal study conduction. As such, a task remains that would examine the relationship between 4NCD and the contexts within which they occur over some time for clarity on the cause-and-effect relationship. Furthermore, a study to investigate the factors contributing to high premature diabetes mortality in Seychelles, is needed for effective interventions. Likewise, the significant difference in diabetes-related deaths among UN Member States in the IDF East and West Africa regions should be investigated to enable localized interventions. Lastly, data on other relevant contextual factors that could be impacting diabetes-related deaths were unavailable.

**Table 1. Model summary for regression model.**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	0.752 <sup>a</sup>	0.565	0.471	0.07306	b

<sup>a</sup>Predictors: (Constant), Physicians (per 1,000 people), 2016-2018, Voce and Accountability: Estimate, 2018, Individuals using the internet (% of population), 2016-2017, Unemployment (% of total labor force) (modeled ILO estimate), 2018. <sup>b</sup>Not computed because fractional case weights have been found for the variable specified on the WEIGHT command.

**Table 2. ANOVA for regression model.**

Model	Sums of squares	df	Mean square	F	Sig.
Regression	0.128	4	0.032	5.973	0.0003 <sup>b</sup>
Residual	0.098	18	0.005		
Total	0.226	22			

<sup>b</sup>Predictors: (Constant), Physicians (per 1,000 people), 2016-2018, Voce and Accountability: Estimate, 2018, Individuals using the internet (% of population), 2016-2017, Unemployment (% of total labor force) (modeled ILO estimate), 2018.

**Table 3. Coefficients for regression model.**

Predictor	Coefficient (SE)	95% CI	Standardized coefficient ( $\beta$ )	Sig.
Intercept	0.122 (0.034) **	0.051 – 0.194		
UNE	0.007 (0.010)	-0.014 – 0.028	0.209	
IUI	0.001 (0.001)	-0.001 – 0.003	0.197	
VA	-0.062 (0.020) **	-0.104 – -0.020	-0.501	
PPP	0.143 (0.116)	-0.101 – 0.386	0.316	

\*\* $p < 0.01$ .

There was no control over data accuracy as secondary data were employed in the study.

## Discussion

In the statistical analysis where cases were weighed on country size, a significant positive correlation was observed between UNE and diabetes-related deaths in individuals 20-79 years per 1,000 people  $r(32)=0.56$ ,  $p=0.001$ ; IUI and diabetes-related deaths in individuals 20-79 years per 1,000 people  $r(32)=0.34$ ,  $p=0.059$  also seemed to approach a positive significant correlation. VA and diabetes-related deaths in individuals 20-79 years per 1,000 people appeared to be approaching a significant negative correlation at  $r(32)=-0.35$ ,  $p=0.072$ . Meanwhile, PPP and diabetes-related deaths in individuals 20-79 years per 1,000 people showed a strong positive significant correlation at  $r(32)=0.47$ ,  $p=0.011$ . MDEP, and diabetes-related deaths in individuals per 1,000 people also showed a strong positive significant correlation at  $r(32)=0.40$ ,  $p=0.026$ . However, MDEP was excluded from the regression model because it was positively correlated with UNE to prevent multicollinearity in the model. As previously stated, past studies had established the linkage of unemployment with premature NCD mortality and physician per 1,000 as an essential component in health outcomes. Likewise, diabetes-related expenses are vital for diabetes medication and routine management services associated with laboratory tests, physician services, and kidney analysis. The availability of funds is critical to whether individuals living with diabetes die prematurely or not. Similarly, living in an information technology era, the increasing number of individuals who have access to the internet can access information regarding their disease condition and make informed decisions. Equivalently, voice and accountability, a dimension of governance, is vital in facilitating health outcomes and was the dominant predictor that explains the variability of diabetes-related deaths in individuals 20-79 years per 1,000 people when cases were weighted on country size.

Among the predictor variables included in the regression model, voice and accountability being the dominant predictor variable explaining diabetes-related death variability is consistent with previous studies that showed that citizens' voice and accountability are essential dimensions of governance. This governance dimension enables citizens to express their preferences and be heard by the state through formal or informal channels, in written or oral form.<sup>23</sup>

When citizens' influential voice conveys their views; and governments or states are held accountable for their actions, public needs and demands are responded to promptly.

Voice and accountability have demonstrated to have some positive effects, such as raising awareness, empowering some marginalized groups, and encouraging state officials.<sup>23,24</sup> Furthermore, voice and accountability allow individuals to secure rights and make demands on the state to achieve better development outcomes.<sup>24</sup> More so, the WHO identifies governance, including voice and accountability, as a health system building. Notably, civil engagement assures the presence of a strategic policy framework that allows for effective accountability, regulation, oversight, coalition-building, and attention to system-development.<sup>25</sup>

Past studies show that community participation advocacy, a form of voice, is a health-improving strategy, where community representatives are included in health facility committees.<sup>26</sup> Moreover, through community engagement, proposed premature NCD mortality reduction initiatives can be achieved.<sup>27</sup> Likewise, public engagement, such as accountability between governments and citizens, allows for monitoring commitments made by governments, policymakers, industries, academia, and civil society to ensure they become a reality.<sup>27,28</sup> Voice and accountability promote transparency in policy-making, resource allocation, and performance. This process generates accountable leadership responsible for addressing public health priorities,<sup>25</sup> such as attaining the SDG 3.4.

## Conclusions

With less than a decade to the SDGs attainment, there is a need for increased voice and accountability to ensure that adequate and timely routine NCD management services and funds are provided to achieve a progressive decline in premature NCD mortality to attain in part SDG 3.4. Accessibility of relevant information must be available to stakeholders for performance evaluation, and defaulters must face necessary consequences, including the governments.<sup>2</sup>

Voice and accountability and other governance and leadership dimensions are critical in improving health outcomes yet remain poorly monitored and evaluated amongst the UN Member States in Africa.<sup>2</sup> There is a need to scale-up efforts by considering the implication of this critical contextual factor in SDG 3.4 attainment,

through contextual customization that addresses internal dynamics for effective strategic execution and long-term sustainability of premature NCD mortality reduction.<sup>29</sup>

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