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# Cardiovascular Risk Factors in Adult Patients with Type II Diabetes in Western Kenya

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A B S T R A C T

This study investigates the risk factors associated with cardiovascular disorders among adult patients with type II diabetes in western Kenya. Acrossectional quantitative study was conducted among randomly selected type II diabetic patients aged 18 years and above. Data was collected through questionnaires and medical examination. The study found a high prevalence of obesity, hypertension and dyslipidemia among the participants indicating a significant risk of cardiovascular disorders in this population.

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## INTRODUCTION

Cardiovascular diseases are defined by a constellation of interconnected physiological, biochemical, clinical, and metabolic factors that directly increases the risk of cardiovascular disease, type 2 diabetes mellitus, and all-cause mortality (Kaur, 2014). Insulin resistance, visceral adiposity, atherogenic dyslipidemia, endothelial dysfunction, genetic susceptibility, elevated blood pressure, hypercoagulable state, and chronic stress are the several factors which constitute the syndrome (Kassi et al., 2011). Chronic inflammation is known to be associated with visceral obesity and insulin resistance which is characterized by production of abnormal adipocytokines such as tumor necrosis factor α, interleukin-1 (IL-1), IL-6, leptin, and adiponectin (Dumas et al., 2014).

The interaction between components of the clinical phenotype of the syndrome with its biological phenotype (insulin resistance, dyslipidemia, etc.) contributes to the development of a proinflammatory state and further a chronic, subclinical vascular inflammation which modulates and results in atherosclerotic processes that leads to cardiovascular diseases (Timar et al., 2014). Lifestyle modification remains the initial intervention of choice for such population; modern lifestyle modification therapy combines specific recommendations on diet and exercise with behavioral strategies. Pharmacological treatment should be considered for those whose risk factors are not adequately reduced with lifestyle changes (Fuentes et al., 2013).

Pre- diabetes represents an elevation of plasma glucose above the normal range but below that of clinical diabetes. Pre-diabetes can be identified as either impaired fasting glucose (IFG) or impaired glucose tolerance (IGT), pre-diabetes commonly associates with the cardiac related conditions (Scott M. Grundy, 2012). Both in turn are closely associated with obesity, the mechanisms whereby obesity predisposes to pre-diabetes and metabolic syndrome are incompletely understood, but likely have a common metabolic soil. Insulin resistance is a common factor; systemic inflammation engendered by obesity may be another (Gillingham et al., 2011). Pre-diabetes has only a minor impact on micro vascular disease; glucose- lowering drugs can delay conversion to diabetes, but whether in the long run the drug approach will delay development of micro vascular disease is in dispute (Gillingham et al., 2011). To date, the drug approach to prevention of micro vascular disease starting with pre-diabetes has not been evaluated (Gillingham et al., 2011). Pre-diabetes carries some predictive power for macro vascular disease, but most of this association appears to be mediated through the cardiovascular diseases. The preferred clinical approach to cardiovascular prevention is to treat all the metabolic risk factors (S M Grundy, 2012). For both pre-diabetes and cardiovascular diseases, the desirable approach is lifestyle intervention, especially weight reduction and physical activity. When drug therapy is contemplated and when the cardiovascular diseases is present, the primary consideration is prevention of cardiovascular disease (S M Grundy, 2012). It has been realized that certain cardiovascular disease associated risk factors symptoms often occur together, and that these symptoms predict the

development of diseases. The combination of hypertension, hyperglycemia and hyperuricemia was reported as early as the 1920s (Gillingham et al., 2011).

There is now substantial evidence that resistance to insulin- stimulated glucose uptake is a common phenomenon, associated with glucose intolerance, dyslipidemia, high blood pressure and coronary heart disease (Gillingham et al., 2011). Furthermore, these cardiac related abnormalities tend to cluster together in some individual (Williams et al., 2015). World Health Organisation (WHO) suggested the existence of cardiac associated risk factors in the late 1980s, in which insulin resistance was the primary defect, associated with hyperinsulinemia and also proposed that the insulin resistance syndrome be titled syndrome X. Later this syndrome was strongly associated with other aberrations, most notably with visceral obesity, and called "the deadly quartet" or the glucose intolerance, hypertension and obesity (GHO) syndrome or the metabolic cardiovascular syndrome (metabolic syndrome), (Reaven, 2005). A series of studies have demonstrated that women with GDM are at risk of developing cardiovascular associated risk factors in the years following their index pregnancy (Gillingham et al., 2011).

Furthermore emerging evidence shows that components of the cardiovascular associated risk factors identified in early gestation and even prior to pregnancy can predict the subsequent development of GDM (Delgado-Lista et al., 2014). Taken together, these findings have raised the intriguing possibility that women who develop GDM may have underlying latent cardiovascular associated risk factors that warrants clinical evaluation and risk factor modification. Though intricate and still incompletely understood, the gradual expansion of knowledge about inter-relationships between the cardiovascular associated risk factors, GDM and T2DM may provide us with opportunity to screen for and detect metabolic dysfunction at various stages of disease progression (Poudyal et al., 2011).

Cardiovascular associated risk factors are known to be a complex interaction between genetic, metabolic and environmental factors. Among the environmental factors there is no doubt that dietary habits and lifestyle are of central importance in the prevention and treatment of cardiac related risk factors. The underlying causes of cardiovascular diseases and the specific diagnostic criteria used to identify it also remain a matter of debate (Gillingham et al., 2011). What scientists do agree on is the need to identify patients/individuals at high risk of early morbidity and mortality from both cardiovascular disease (CVD) and type 2 diabetes before they develop one or both conditions (Vogt et al., 2014).

## THEORETICAL REVIEW

Cardiovascular diseases are defined by a constellation of interconnected physiological, biochemical, clinical, and metabolic factors that directly increases the risk of cardiovascular disease, type 2 diabetes mellitus, and all-cause mortality (Kaur, 2014). Insulin resistance, visceral adiposity, atherogenic dyslipidemia, endothelial dysfunction, genetic susceptibility, elevated blood

pressure, hypercoagulable state, and chronic stress are the several factors which constitute the syndrome (Kassi et al., 2011). Chronic inflammation is known to be associated with visceral obesity and insulin resistance which is characterized by production of abnormal adipocytokines such as tumor necrosis factor α , interleukin-1 (IL-1), IL-6, leptin, and adiponectin (Dumas et al., 2014). The interaction between components of the clinical phenotype of the syndrome with its biological phenotype (insulin resistance, dyslipidemia, etc.) contributes to the development of a proinflammatory state and further a chronic, subclinical vascular inflammation which modulates and results in atherosclerotic processes that leads to cardiovascular diseases (Timar et al., 2014). Lifestyle modification remains the initial intervention of choice for such population; modern lifestyle modification therapy combines specific recommendations on diet and exercise with behavioral strategies.

## METHODOLOGY

### Study Design

This was a cross-sectional study on determining the associated cardiovascular disorders among adult patients with type II diabetes mellitus in western Kenya. It involved determination of indicators associated with cardiovascular diseases which included waist circumference, body mass index, and blood pressure, and from these the prevalence of the associated risk factors or indicators in the study population was worked out.

### Study Area

The study area was diabetic clinics in Webuye, Bungoma and Kakamega district hospitals in western Kenya region.

### Population and Sample Size Determination

The participants were diabetic patients attending selected diabetic clinics in district hospitals in western Kenya. A sample size was determined using Wyne Daniel (1986) method in which the sample size is given by the expression:

N= Z2pq/d2
n= desired sample size
Z = Standard normal deviation usually set at 1.96 for maximum sample at 95 size % confidence level.
p= the proportion of study population that are at risk and associated risk factors for Cardiac related conditions (6.25%) (WHO 2010);
q = 1-p = 1-0.0625 = 0.93725 and,
d= Amount of error (at 95% confidence level or 0.05 probability level).

By Substitution we get:
N = 1.962x 0.325 x 0.4375/ 0.05 x 0.05
= 202 participants

**Inclusion Criteria**

To be included were all diabetic type II patients above 18 years available during time of data collection and met the selection criteria and consented.

**Exclusion Criteria**

All those that did not meet the inclusion criteria and did not consent.

**Sampling Procedure and Sampling Methods**

Section/group of participants was chosen to represent the entire population under the study. The participants were reached through random selection where the respondents were selected randomly whoever was present at the time of selection and met the inclusion criteria was requested to sign the consent form as a sign of accepting and they were interviewed and requested to fill the questionnaires, and the anthropometric measurements was taken.

**Data Collection Tools**

Blood pressure machine, stethoscope, tape measure and 180kg weighing machine were tools used to take measurements and questionnaires in which questions concerning ethnicity, age, sex, dietary intake, smoking and drinking history, level of exercise, and physical activities was formulated to collect information from respondents. The data from anthropometric measurements was entered in a pre-determined data collection form in which the measurement was entered as they are taken.

**Procedure**

The first stage involved participants being evaluated for body weight, height and blood pressure. Before taking the anthropometric measurements which was determined using standard methods measurements, a questionnaire was given to each participant to complete. The participants was then weighed on a platform-type balance with a capacity of up to 160 kgs, with the help of a female trained research assistant, who explained the procedure to the participant. The weight measurement was made with the participant wearing light clothes and without shoes, standing upright at the centre of the balance, with their arms extended down the sides of the body and the head positioned perpendicular to the floor. The height measurements were taken using mm scale attached to a wooden set square with a lock, fixed against the wall. The body mass index (BMI) was expressed in kg/m2 (BMI was calculated as the weight of the individual in kilogram divided by the square of the height in meters). Waist and hip circumference was determined, when light clothed; using a graduated tape measure and the waist to hip ratio was calculated.

The variables and diagnostic criteria for systolic blood pressure (SBP) and diastolic blood pressure (DBP) was determined by measuring three times the arterial blood pressure in the right arm using a mercury sphygmomanometer, with the participant in a seated position. The first and fifth Korotkoff sounds were used to represent SBP and DBP respectively and

then the mean from the three measurements was used in the analysis. Hypertension was defined as any blood pressure (Systolic and/or Diastolic) that was greater than or equal to 130/90mmhg.

**Data Presentation**

The data collected from the study area was presented in form of tables and figures after calculations of means and standard errors, pie charts and bar graphs.

**Statistical Analysis**

Statistical relationships were determined using SPSS and a Statistician was consulted during data analysis.

**Ethical Considerations**

Ethical approval was soughed from the respective hospital ethical committee. Also, participants signed an informed consent statement for their participation after a thorough explanation of the procedure and importance of the study to them. Every participant had the right to refuse to participate by not signing the consent form or to withdraw from the study if they feel un comfortable at some stage. For the purpose of confidentiality, questionnaires only used identification codes but not names. Two trained, and qualified female nurses were recruited as research assistants who assisted in the collection of blood samples from the respondents. Other two female research assistants were responsible for taking Anthropometric measurements.

## RESULTS

### A. Demographic Data

Table 1. Respondent by Age

| *Age* | *Respondent* | *%* |
|---|---|---|
| ***18 – 29*** | 107 | 53 |
| ***30 – 49*** | 63 | 31 |
| ***50 – 69*** | 20 | 10 |
| ***70 above*** | 12 | 6 |
| ***Total*** | **202** | **100** |

The table above shows respondent by age, which shows that most of respondent by age lies between 18 – 29(53%), 30 – 49(31%), 50-69(10%) and 70 years 12(6%).

Table 2. Respondent by Marital Status

| *Marital Status* | *Respondent* | *%* |
|---|---|---|
| ***Single*** | 35 | 35 |
| ***Married*** | 102 | 50 |
| ***Divorced*** | 15 | 7 |
| ***Widows*** | 9 | 4 |
| ***Separated*** | 6 | 3 |
| ***Total*** | **202** | **100** |

Most of respondent by age 102(50%) were married, followed by 70(35%) single, 21(10%) either, divorced or separated and widows 9(4%).

Table 3. Respondent by Occupation

| ***Occupation*** | ***Respondent*** | ***%*** |
|---|---|---|
| *employed* | 75 | 37 |
| *Self employed* | 87 | 43 |
| *Not employed* | 40 | 20 |
| ***Total*** | **202** | **100** |

Most of the respondent 87(43%) self employed, 75(37%) and 40(20%).

Table 4. Respondent by Educational Level

| ***Educational Level*** | ***Respondent*** | ***%*** |
|---|---|---|
| *Informal education* | 40 | 20 |
| *Primary level* | 70 | 35 |
| *Seconday level* | 70 | 35 |
| *Tertiary level* | 22 | 10 |
| ***Total*** | **202** | **100** |

Most of the respondent 70(35%) had primary level, and 70(35%), informal education 40(20%) and finally 22(10%) had tertiary education.

**B. Arthropometric Measurements**

***BMI (Body Mass Index)***

Table 5. BMI of the Participants

| ***BMI*** | ***Category*** | ***Freq*** | ***%*** |
|---|---|---|---|
| *18.00 - 25.00* | Healthy weight | 54 | 26.7 |
| *25.10 - 30* | Overweight | 36 | 17.8 |
| *>30.00* | Obese | 112 | 55.4 |
| ***Total*** | | **202** | **100** |

Most (55.4%) of the participants were Obese while 26.7% had a healthy weight as shown in the table 1 above.

***Blood Pressure***

Tabel 6. Blood Pressure of the Participants

| ***Blood pressure*** | ***Category*** | ***Frequency*** | ***Percentage*** |
|---|---|---|---|
| ***90/60-130/90*** | Healthy | 62 | 31 |
| ***131/91-179/109*** | Hypertensive | 121 | 60 |
| ***>180/110*** | Hypertensive emergency | 19 | 9 |

Most of the participants were hypertensive (60%) while 9% had hypertensive emergencies.

**C. Blood Chemistry**

***Blood Picture Fasting Blood Glucose***

Table 7. Fasting blood sugar of the participants

| ***Blood sugar*** | ***Category*** | ***Frequency*** | ***%*** |
|---|---|---|---|
| ***≤7.6mmol/l*** | **Normal** | **70** | **34.7%** |
| ***≥7.7mom/l*** | **Above normal** | **132** | **65.3%** |

Most of the participants (65.3%) had blood sugar above normal while only 34.7% of the respondents had normal blood sugar.

***Lipid Profile***

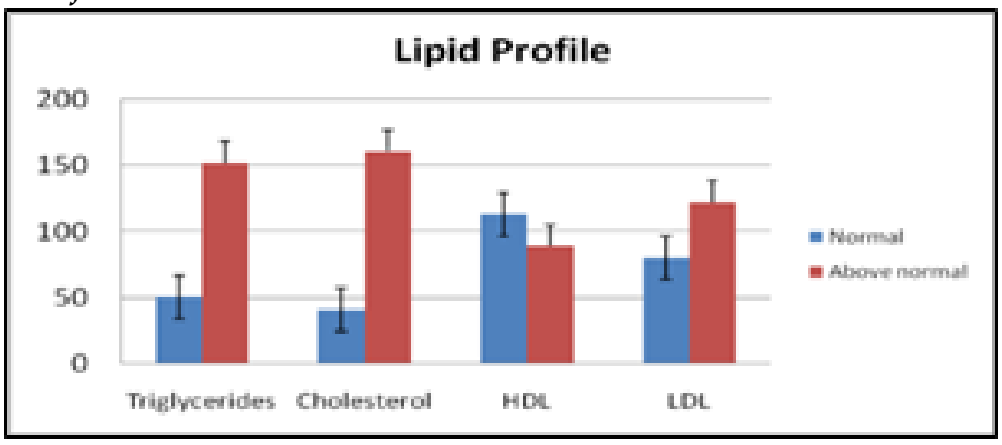


Figure 1. Lipid Profile of the Participants

The triglyceride and cholesterol levels of the participants were significantly higher at a P<0.05. The HDL levels were normal in 55% while the LDL levels were significantly increased in 60% of the participants.

**D. Prevalence of Metabolic Syndrome**

***Prevalence of Indicators of Metabolic Syndrome***

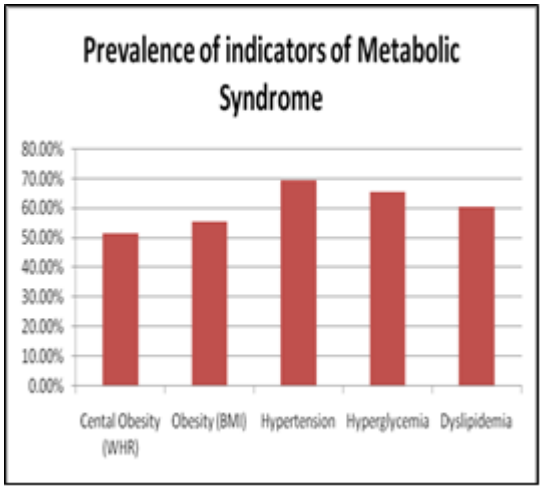


Figure 2. Indicators of Metabolic Syndrome

Most of the participants were hypertensive (69%) while 50% had central obesity. General obesity, hyperglycemia and dyslipidemia were also common among the participants.

**Associated Risk Factors to Cardiovascular Disorders**

Table 8. Associated Risk Factors to Cardiovascular Disorders Present in the Participants

| *Indicators present* | *Freq* | *Percentage* |
|---|---|---|
| ***1. Hypertension*** | 39 | 19.4% |
| ***2. Hyperglycemia*** | 89 | 44% |
| ***3. Dyslipidemia*** | 44 | 21.8% |
| ***4. Obesity (Increased BMI)*** | 30 | 14.9% |
| ***5. Central Obesity (WHR)*** | 202 | 100% |

The participants had mostly two indicators of cardiovascular associated risk factors. A total of 36.7% of the participants had 3 and 4 cardiovascular associated risk indicators.

**DISCUSSION**

In this cross-sectional study, a total of 202 adult, aged 18 years and above, in selected district hospitals in western Kenya were included. According to the US National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) guidelines, MetS was diagnosed in subjects with three or more of the following: waist circumference > or =88 cm, blood pressure > or =130/85 mmHg,

and glucose > or =110 mg/dl which are the main associating risk factors that exposes to cardiovascular disorders. Data on past medical history, tobacco use, anthropometric indicators, were collected. Multivariate analysis, using a logistic regression model (odds ratio, OR) was used to evaluate the influence of various simultaneous cardiovascular associated risk factors. Demographic characteristics (age, sex, and race) and education were collected via self- report on standardized questionnaires at each examination. Regular leisure time and work- related physical activities were assessed by a validated interview-administered questionnaire. Participants whose self-reported physical activity was above the median of the baseline sample distribution at all four examinations were classified as maintaining regular physical activity.

In the study finding it revealed that the prevalence of self-reported hypertension was 60 and 6% hypertensive emergency in the participants in this community. The higher prevalence in this community can possibly be due to the lifestyle of the participants. The prevalence of self-reported diabetes mellitus was 65.3% in the study populations also may be related to the lifestyle of the respondents in the community. It was also found that the control of hypertension and diabetes in these communities was problematic. Despite being on treatment for hypertension, 69% of participants presented with increased blood pressure. These findings were clearly indicative of poor control of hypertension, which was one of the main reasons for referral after medical examination in this community.

Although some patients were receiving treatment for diabetes mellitus, results from blood glucose levels nevertheless indicated elevated fasting blood glucose levels, namely that low levels of physical activity were higher in study area. The markedly higher self-reported physical inactivity levels (66.5%) could be attributed to the more sedentary lifestyle in western Kenya communities due to the availability of public transport and less physically active occupations in community. Limited information was available on the premature mortality rate due to chronic lifestyle diseases in different socio-economic areas in western Kenya region, indicates a 39% and 33% premature mortality in rich and poor districts, respectively. Our study illustrates the presence of major risk factors for chronic diseases of lifestyle in both study populations and identified hypertension (self-reported), as well as overweight and obesity, due to physical inactivity (self-reported), which is the major threats in the this community. 40% of the study population had a higher cumulative associated risk factors or indicators of 3 or more risk factors for cardiovascular disorders or diseases.

Identifiable associated risk indicators for cardiovascular disorders, which included, increased waist circumference, raised blood pressure or a history of hypertension treatment, amongst this population, was the most common risk factor associated with cardiovascular disorders (60.9%), whilst elevated fasting blood glucose was identified as the least prevalent (22.6%). Participants revealed higher risk for different risk factors for cardiovascular disorders. The study revealed that 52.2% of the study population participants were identified with three or more risk factors associated with cardiovascular disorders.

This study highlights the need for serious recognition of the increasing burden of lifestyle diseases and cardiovascular disorders in Kenya. The escalating healthcare cost associated with the risk profiles indicated in this study, presents a specific challenge to healthcare providers, researchers, government officials and the general population. Once risk factors have been identified lifestyle intervention programmes can improve the overall health profile of the communities.

Intervention programmes, for example dietary programmes that encourage better control of existing diseases such as hypertension, diabetes and dyslipidemia, can form the cornerstones of a healthier community. Physical activity programmes (e.g. community fitness programs) can facilitate weight control and promote overall physical health. Patients with a specific risk profile, for example, where associated risk indicators to cardiovascular disorders has been identified, will benefit significantly from intensive dietary and exercise programmes to improve blood glucose levels, lipid profiles, waist circumference and lower blood pressure. The development and implementation of relevant health-promoting and -intervention strategies that are cost-effective and culturally sensitive, with the aim to improve the general health and reduce the risk for chronic diseases of lifestyle and metabolic syndrome in these populations, are therefore urgently advised. Another risk factor for chronic lifestyle diseases that was found to be a major problem, especially in the study population, was obesity. In our study population, 55.4% of participants were found to qualify to be obese and only 26.7% had normal weight.

Nearly one-quarter of adults participants have the associated cardiovascular risk indicators, a clustering of abnormal blood glucose level, blood pressure, and abdominal adiposity. A number of studies have investigated the cross-sectional and prospective association of the cardiovascular disorders with type 2 diabetes like coronary heart disease. Determining who is at risk for the cardiovascular disorders has been an equally high priority. However, relatively fewer studies have investigated this association prospectively using a comprehensive set of risk factors in a diverse population sample. Although obesity has consistently been reported as a risk factor for the cardiovascular disorders, the association of health behaviors and dietary composition with the development of cardiovascular diseases is less well studied, particularly in western Kenya.

Furthermore, these risk factors along with demographic characteristics have most often been evaluated individually instead of in a multivariable setting, which could more appropriately identify multifactorial origins of the cardiovascular disorders. Thus, we investigated whether demographic characteristics and risk factors correlated with the cardiovascular disorders in cross-sectional studies and based on a prior knowledge predicted development of the disorders over 15 years. Cardiovascular disorders risk increased with age and was higher among participants and those with less than a high school education.

The risk of cardiovascular disorders increased with age and was higher among participants and those with the least education. Physical activity was inversely associated with cardiovascular disorders associated risks. BMI was the only characteristic that was a significant predictor of cardiovascular disorders, but trends for risk factors were generally in a similar direction. Most of the same associated risk factors remained predictive of cardiovascular disorders, with the exceptions that the inverse association of cardiovascular disorders with physical activity and fiber intake attenuated to non-significance, and high levels of dietary fat were associated with cardiovascular disorders risk indicators. Again, higher BMI was the only factor that remained significantly associated with cardiovascular disorders due to weight gain which associated with an increased risk for cardiovascular disorders in the total sample. This association persisted independent of all associated risk indicators. Regular physical activity over time was inversely associated with the cardiovascular disorders risk independent of weight gain, demographic characteristics, and other risk factors in the total population.

## CONCLUSIONS AND RECOMMENDATIONS

The study reveals a high prevalence of cardiovascular risk factors, including obesity, hypertension and dyslipidemia among adults with Type II diabetes in Western Kenya. These findings highlight the need for targeted health interventions in this population to manage these risk factors and prevent cardiovascular disorders. Increased number of diabetes type II majorly is due to sedative lifestyle among the young adults and intervention measures should be applied immediately to control diabetes type II which is now a public threat.

Based on the findings of this survey, we recommend specific strategies targeting these known associated cardiovascular risks indicators that could substantially impact on the disease profile of these communities. These strategies included the following:

1. The introduction of education and awareness programmes that focus on the current emerging trend of chronic diseases of lifestyle and cardiovascular disorders in these communities.
2. Efficient and targeted lifestyle intervention programmes that focus on intensive dietary and exercise programmes to reduce the associated risk indicators identified by this investigation.
3. The poor control of hypertension and diabetes clearly indicates the need for optimally accessible primary healthcare provided by community health centres.

## FURTHER STUDY

For Further Study, they can indicate which combinations of the associated risk indicators criteria best predict cardiovascular risk in these communities. Follow-up studies to investigate the impact of implemented lifestyle intervention programmes in these rural communities.

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