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Research Article

Non-Communicable Diseases, Associated Factors and Cardiovascular Risk Stratification in the Adult Population Attending a Rural Hospital in Northern Sri Lanka: A Cross-Sectional Study

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Abstract

Background

Non-Communicable Diseases (NCD) account for over 80% of deaths in Sri Lanka, with cardiovascular disease at a prevalence of 6.76%. Multiple modifiable and non-modifiable factors contribute to cardiovascular risk. However, data among adults in Sri Lanka's rural areas is sparse. This study aims to determine the proportion of people with NCDs, describe the risk factors, determine the cardiovascular risk according the World Health Organization cardiovascular risk stratification, and determine the factors associated with cardiovascular risk among adult patients patronizing Primary Medical Care Unit Bogaswewa.

Methods

A descriptive cross-sectional study design was carried out at a rural hospital in the Northern Province in Sri Lanka, with data previously collected during a screening programme of 578 villagers selected using a convenient sampling technique. Descriptive statistics were used for analysis, and bivariate (chi-square) and multivariate analysis was carried out to determine the factors associated with cardiovascular risk. A value of $p<0.05$ was taken as statistically significant.

Results

The majority was female (74.2%). The mean age was 55.6 years (SD-12.115), with most under the age of 60 (77.3%). NCDs were present in 58.3%. A total of 12.1% were newly diagnosed with an NCD. While only 14% and 13% of participants consumed alcohol and smoked respectively, 32% chewed betel, and only 39.1% had elevated blood pressure. Only 32.7% had a high cardiovascular risk. Bivariate analysis showed that those above 60 years ($p>0.001$), males ($p>0.001$), those with positive family history ($p>0.001$), elevated blood pressure ($p>0.001$), alcohol consumers ($p=0.030$), tobacco smokers ($p=>0.001$), betel chewers ($p=0.017$), those with a sedentary lifestyle ($p=0.002$) and elevated fasting blood sugar and serum creatinine levels ($p>0.001$) were at a high risk for cardiovascular disease. Following multivariate analysis age ($p>0.001$), hypertension ($p>0.001$), smoking ($p>0.001$) and fasting blood sugar ($p>0.001$) were found to be strong predictors of cardiovascular risk.

Conclusion

Majority of the rural population were found to have a NCD though most had a low cardiovascular risk. Risk factors for NCDs were present among many. The factors significantly associated with cardiovascular risk could be taken into consideration when planning preventive interventions for this and other rural communities.

Keywords: Cardiovascular risk stratification; Diabetes mellitus; Hypertension; Non-communicable diseases; Obesity; Rural health

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Background

Non-Communicable Diseases (NCDs) are a group of medical conditions that cannot directly be transmitted from person to person. It encompasses cardiovascular diseases such as hypertension and coronary heart disease, as well as stroke, cancer, diabetes mellitus and lung diseases including asthma and chronic obstructive pulmonary disease. The World Health Organization (WHO) has stated that NCDs are the leading cause of death worldwide at 41 million (amounting to 74% of all deaths), with cardiovascular disease accounting annually for nearly half at 17.9 million (which is 43.7% of all deaths) [1]. The majority of these NCD deaths affect middle to low income countries. Many of these deaths occur prematurely, before the age of 70, which represents approximately 41% of deaths globally [1]. In Sri Lanka, it is estimated that over 80% of deaths are due to NCDs [2]. The risk factors that contribute to the development of NCDs can be divided into modifiable risk factors (smoking, alcohol, diet, inactivity, high blood pressure, high body mass index) and non-modifiable risk factors (age, sex, genetic predisposition) [3].

Cardiovascular risk is the likelihood of developing coronary heart disease, stroke or peripheral vascular disease within a given time frame [4]. Ischaemic heart disease is the leading cause of death in Sri Lanka and is also a consequence of the NCD risk factors mentioned above [5,6]. Screening for these risk factors is vital as it aids in early

detection, leading to timely intervention to implement measures to reduce the risk of developing these diseases, or prevent the progression to significant disease [6]. This will improve morbidity and contribute to reducing mortality [7]. Once the factors have been identified, a risk assessment tool can be used to calculate cardiovascular risk.

One example is the WHO/International Society of Hypertension (WHO/ISH) Cardiovascular Risk Charts, with or without laboratory tests, which are used to stratify risk by providing an estimate of the risk of developing a cardiovascular event within the next ten years [8]. The risk can be categorized as less than 10% being low risk, 10-20% being moderate risk, and more than 20% being high risk. Cardiovascular risk prediction along with the proper management of NCDs, are important in reducing morbidity and mortality in Sri Lanka [9].

In Sri Lanka, as life expectancy has increased and a quarter of the population is expected to be elderly by 2041 [10]. This, along with rapid urbanization, leading people to forgo physical activity and adopt a sedentary lifestyle [11], in addition to propagation of other risk factors makes it imperative that early detection of NCDs and risk stratification is done [12].

An explanatory mixed-methods study on the outcomes and challenges in NCD care provision in health facilities supported by the Primary Health Care System Strengthening Project (PSSP) in Sri Lanka using data from 9 different Primary Medical Care Institutions conducted by D. Nair et al in 2023 [13], found that only 45% of those with NCDs registered for follow up care. In addition, in patients already diagnosed with diabetes, only 40% had blood sugar levels under satisfactory control, and only one out of two patients with hypertension had normal blood pressure, highlighting a gap in current healthcare provision. Research done in an urban health administrative area on risk estimates of cardiovascular diseases in a Sri Lankan community by Ranawaka et al. [14], used three risk prediction tools to estimate the risks of coronary heart disease, total cardiovascular disease and cardiovascular mortality. In this study, 8.2% of the participants were classified as having 'high risk' for total cardiovascular disease according to the WHO/ISH system. The prevalence of coronary artery disease in this area was 6.9%. A comparable prevalence in a rural region could not be found. The 2021 Global Burden of Disease study showed a cardiovascular disease prevalence of 6.76% in Sri Lanka [15].

While urban populations have been studied multiple times, the amount of research done on the proportion of NCD's and cardiovascular risk stratification in rural areas of the country is limited, particularly in the northern part of the country, which was ravaged by a three-decade-long war. A comprehensive study of such a region would be beneficial to tailor better healthcare provision, which in turn will lead to reduction in morbidity and mortality, ultimately making healthcare interventions effective. The aim of this study is to describe the proportion of rural population with NCDs, to describe the factors associated with NCDs in this population, to determine the cardiovascular risk according the World Health Organization cardiovascular risk stratification, and to determine the factors associated with cardiovascular risk among adults attending PMCU Bogaswewa.

Methods

Study Design and Population

Primary Medical Care Unit (PMCU) Bogaswewa is located in the Northern province of Sri Lanka, in the district of Vavuniya, and is the sole hospital in the Pirappanmaduwa Grama Niladhari division [16]. The nearest tertiary care hospital is District General Hospital, Vavuniya, located 42 kilometers away. The hospital caters to the villagers in the region and provides Daily Outpatient Department (OPD) services, in addition to an emergency unit, medical clinic, antenatal clinic, minor surgical facilities and other health-related services. It is patronized by approximately a hundred patients daily, with a total of 12,203 OPD visits in 2023.The Primary Healthcare-System-Strengthening Project (PSSP) was an initiative of the Ministry of Health, supported by funding from the World Bank that aimed to improve the quality of medical care provided in primary healthcare settings [6,7]. One component of the programme was the provision of facilities to screen individuals for NCDs and perform WHO Risk Stratification. This was initiated at PMCU Bogaswewa in 2023, as the sole first-point-of-contact healthcare institution in this underserved region, and was carried out by the medical officer in charge.

The hospital was chosen as the setting for a descriptive cross-sectional study, utilizing the records of 578 villagers above the age of 30 who presented for the screening programme.

Data Collection

A Personal Health Record (PHR) issued by the Ministry of Health was given to each participant during the screening, in which their socio-demographic details, clinical history and examination findings were noted. It was retained at the hospital to be completed once laboratory investigation results were available, and also entered onto the Ministry of Health website. A record was kept at the hospital. All 578 records of screening conducted from March 2023 to May 2024 were used for the study.

Ethical review clearance was obtained from the Postgraduate Institute of Medicine, Colombo, on 27.08.2024 (ERC/PGIM/2024/102).

Data was entered into a Microsoft Excel spreadsheet after cross-checking with the individual Personal Health Records and register maintained at the hospital. This included pertinent information including demographic details such as age and gender, risk behavioural history such as the level of physical activity, alcohol consumption, smoking, betel chewing and unhealthy snack intake, past medical history, examination findings like blood pressure, height, weight and body mass index, investigation findings including fasting blood sugar (FBS), serum creatinine and total cholesterol, the 10 year WHO cardiovascular risk prediction and the outcome of the patient.

Statistical Analysis

A copy of the above was used with all personal identifying details removed. Data was analyzed using the SPSS (Statistical Package for Social Sciences) version 25 to determine the proportion with NCDs, and to describe the cardiovascular risk factors associated with NCDs using descriptive statistics, to describe the cardiovascular risk according to the World Health Organization cardiovascular risk stratification, and after dividing the study population into two groups as those with low and high risk, to cross tabulate risk factors with them, and obtain significance following bivariate (using chi-square) and multivariate (using logistic regression) analysis. A value of $p<0.05$ was used to assess the significance.

Results

A total of 578 patient records were utilized. The majority of participants were female (74.2%). The mean age was 55.6 years

(SD-12.115), with a majority under the age of 60 (77.3%). Of the 578 participants, 58.3% had an NCD. Almost half were already diagnosed (46.2%) and were being followed up in the medical clinic, while 12.1% (n=70) were newly diagnosed after the screening programme. This is illustrated in table 1.

NCD Status	Number (N=578)	Percentage (%)	Confidence Interval (%)
Already Diagnosed	267	46.2%	42.1 - 50.3
Newly Diagnosed	70	12.1%	9.5 -14.8
No NCD Diagnosed	241	41.7%	37.7 - 45.7
Total	578	100%	

Table 1: Prevalence of non communicable diseases in the study population (N=578).

The non-modifiable risk factors are outlined in table 2. A majority of participants had a positive family history of NCDs (57.6%), while only 22.7% were over 60 years of age and 26.8% were male.

Risk Factor	Number (N=578)	Percentage (%)	95% Confidence Interval (%)
Age (years)			
30-44	213	36.9%	33.0-40.9
45-59	234	40.5%	36.5-44.5
Over 60	131	22.7%	19.4-26.3
Sex			
Male	149	25.8%	22.5-29.4
Female	429	74.2%	70.6-77.5
Family History			
Yes	245	42.4%	38.4-46.4
No	333	57.6%	53.6-61.6

Table 2: Frequency and percentage of non-modifiable risk factors among participants (N=578).

Table 3 presents the modifiable risk factors for cardiovascular disease. The level of physical activity revealed that 41.5% led a sedentary lifestyle. Only 14% consumed alcohol, and 13% were tobacco smokers. The number of villagers that chewed betel was 32%. A vast majority (92.5%) over-consumed unhealthy snacks.

Risk Factor	Number (N=578)	Percentage (%)	Confidence Interval (%)
Alcohol Consumption			
Alcohol Consumer	81	14%	11.4-17.0
Teetotaler	497	86%	83.0-88.6
Tobacco Smoking			
Smoker	78	13%	10.6-16.0
Non-Smoker	502	87%	84.0-89.4
Betel Chewing			
Betel Chewer	185	32%	28.1-36.2
Non Chewer	393	68%	63.8-71.9
Physical Activity			
Active	338	58.5%	54.4-62.5
Sedentary	240	41.5%	37.5-45.6
Unhealthy Snack Intake			
Non-Consumer	43	7.4%	5.4-9.8
Consumer	535	92.5%	90.2-94.6

Table 3: Frequency and percentage of modifiable risk factors among participants (N=578).

The examination findings displayed in table 4, show that 26.3% were overweight and 12.3% were obese. Only 39.1% had elevated blood pressure. In the investigation findings, the percentages of individuals with elevated FBS and serum creatinine levels was similar at 12.1% and 14.2% respectively, while 49.7% had elevated blood cholesterol.

Parameter	Number (N=578)	Percentage (%)	Confidence Interval (%)
Body Mass Index			
Underweight	66	11.7%	8.9-14.3
Normal	287	49.7%	45.5-53.9
Overweight	152	26.3%	22.8-30.1
Obese	71	12.3%	9.8-15.2
Blood Pressure			
Normal	352	60.9%	56.8-64.8
Hypertension	226	39.1%	35.2-43.2
Investigation Findings			
Fasting Blood Sugar			
Normal	508	87.9%	85.0-90.4
Elevated	70	12.1%	9.6-15.0
Total Cholesterol			
Normal	291	50.3%	46.1-54.5
Elevated	287	49.7%	43.9-51.9
Serum Creatinine			
Normal	496	85.8%	82.7-88.6
Elevated	82	14.2%	11.4-17.3

Table 4: Examination and Investigation Findings.

The majority (67.3%) had a low cardiovascular risk, while 27.2% had a moderate risk, and only 5.5% had a high risk. These were categorized further into two groups: low risk (67.3%) and high risk (32.7%), the latter combining both moderate and high risk categories.

Cardiovascular risk was cross tabulated with the risk factors, examination findings and laboratory results. The results of factors associated with cardiovascular risk following bivariate analysis are shown in table 5. Among those with high cardiovascular risk, individuals aged 60 and above were the highest at 87%, with only 5.2% in the 35-44 age category ($p<0.001$). The risk was high in males (49.7%) than females (26.8%) ($p<0.001$), and in those with a positive family history (44.9%) ($p<0.001$). Cardiovascular risk was also higher in those with hypertension ((50.9%) ($p<0.001$) than without. Unexpectedly, the majority of those with a high risk had a normal BMI (35.8%) ($p=0.047$). Of those with high cardiovascular risk, the majority were those who consumed alcohol (43.2%) ($p=0.03$), smoked tobacco (56.6%) ($p<0.001$), chewed betel (39.5%) ($p=0.017$) and led a sedentary lifestyle (40%) ($p=0.002$). Among those with high risk, a greater

proportion did not consume unhealthy snacks (48.8%), compared to those who did (31.4%) (p=0.033) which was surprising. Cardiovascular risk was high in those with elevated FBS (61.4%) (p<0.001) and elevated serum creatinine (62.2%) (p<0.001), and while those with elevated serum cholesterol also had a relatively high risk (33.8%), this was not statistically significant (p=0.576). Among individuals at high cardiovascular risk, 43.9% were diagnosed with a NCD (p<0.001) (Table 6).

Parameter	Chi Square - Asymptomatic Distribution
Age	<0.001
Sex	<0.001
Family History	<0.001
BMI	<0.001
Blood Pressure	<0.001
Alcohol Consumption	0.030
Tobacco Smoking	<0.001
Betel Chewing	0.017
Physical Activity	0.002
Unhealthy Snack Intake	0.033
Fasting Blood Sugar	<0.001
Serum Cholesterol	0.576
Serum Creatinine	<0.001
Diagnosis of NCD	<0.001

Table 5: Cross tabulation of cardiovascular risk score versus lifestyle, physical and biochemical factors.

Parameter	P Value (Significance)	Exp(B) (Odds Ratio)	95% CI (Confidence Interval)
Sex	0.998	0.999	0.444-2.248
Age	<0.001	0.011	0.005-0.024
Family History	0.455	0.761	0.371-1.559
BMI	0.874	1.071	0.460-2.495
Blood Pressure	<0.001	0.132	0.070-0.250
Alcohol Consumption	0.547	1.384	0.481-3.977
Tobacco Smoking	<0.001	0.060	0.020-0.183
Betel Chewing	0.802	1.079	0.594-1.960
Unhealthy Snack Intake	0.247	1.764	0.675-4.615
Physical Activity	0.976	0.991	0.542-1.809
Fasting Blood Sugar	<0.001	0.108	0.050-0.231
Serum Cholesterol	0.023	0.510	0.286-0.911
Serum Creatinine	0.218	0.606	0.273-1.345

Table 6: Regression analysis of cardiovascular risk score versus lifestyle, physical and biochemical factors (N=578).

Multivariate analysis showed a significance when the cardiovascular risk stratification (as low risk or high risk) was analyzed against age (p<0.001), blood pressure (p<0.001), smoking (p<0.001) and FBS (p<0.001).

Discussion

This programme, conducted in PMCU Bogaswewa, was the first that has been done since its inception. It is ideal for the purpose of this study because of its remote location and a population that has often been overlooked in other screening events. There are many such villages spread over the country, some with no access to healthcare facilities. Due to a lack of data from similar regions, there is no proper indication of the actual disease burden. A primary aim of this study was to contribute to establish a baseline of the health status of such communities, setting a precedent for future studies, extending coverage to other regions and demonstrating the importance of enhancing diagnostic tools. Although this study analyzed data that had already been collected, it encompassed all the established risk factors for NCDs and included examination and investigation findings that are vital to perform cardiovascular risk stratification. It is therefore extensive enough to give a comprehensive clinical overview, leading to data driven health interventions.

In our study, the majority being female could be attributed to the timing of the screening programme which was held during working hours, during which the men were occupied with farming activities in the paddy fields. Thus, the sample may not be fully representative of the population as a whole in terms of sex distribution. Most of the participants were under the age of 60, explained by the fact that as the village is a farming community, many of its residents are younger in age. Most elders rarely leave their homes and are sometimes bedbound, and are thus unable to travel to the hospital, where the programme was held. Visiting such individuals at their homes could serve to bridge this gap. A positive family history was present in 42.4% of the study population, which could be higher as many villagers were unaware of health problems in their families which hindered their ability to answer accurately. A similar study carried out 8 years prior on the prevalence of coronary artery disease in a semi urban population in Southern Sri Lanka by Jayawadena et al in 2017 found that 32% of the population had NCDs [17]. However, our study detected 58% of the population to have NCDs, which was more than expected. This indicates that even rural populations such as ours, with forgoing of physical activity, indulging in unhealthy snacking habits and increased health-risk behavior are undergoing an epidemiological transition leading to an increase in NCDs.

It was gratifying to note that 12.1% were newly detected to have an NCD, as it demonstrated the effectiveness of the screening programme in identifying 70 individuals that would have otherwise been undiagnosed. Of these, 64 were admitted directly to the medical clinic of the institution, and the remaining 6 required specialized management, and were referred to a tertiary centre. This shows that a significant number of NCDs remain undetected in rural populations, and highlights the importance of screening, particularly in the peripheries and Northern/Eastern parts of the country.

Despite being a rural population, our study population depicted multiple risk factors such as, 14% consuming alcohol, 13% smoking, 32% chewing betel, 41.5% being sedentary, 92.5% having unhealthy snacking habits and 38.6% having an unhealthy BMI pointing toward overweight/obesity. These modifiable risk factors were also present (albeit at higher levels) in a study of male three wheel drivers in an urban region by Dissanayake et al., in 2021 which detected increased smoking, alcohol consumption, betel chewing, increased BMI and poor dietary habits as risk factors [18], highlighting that they are not limited to urban settings. A study by Katulanda et al. [19], of 4485 adults in seven of the nine provinces in Sri Lanka, that assessed the community prevalence, patterns and predictors of Hypertension [18], found that nearly one third (23.7%) of the total population were

hypertensive, with a higher prevalence in urban adults (26.9%) than rural (22.5%). However in our study 39.1% had elevated blood pressure, revealing it to be more prevalent in the population than expected. Further analysis therefore is crucial to detect how many were newly diagnosed, how many were already diagnosed and what their blood pressure control is to assess the adequacy of their current management and enhance provision of care.

More than two-thirds (67.3%) had a low cardiovascular risk, indicating a generally favourable outlook for the future health status of the population. However there was still 27.2% at moderate risk and 5.5% at high risk, which shows that this population is not exempt from the impending threat of serious disease. A study by Jayawardena et al in a semi urban population had a 6.9% prevalence of cardiovascular disease [17], and while the small difference could be attributed to possible risk factors associated with the urban setting, the narrow gap demonstrates that a segment of the rural population in our study is similarly vulnerable. For analytical purposes, those with moderate and high cardiovascular risk were categorized as high risk.

As age increased, so did cardiovascular risk. Among those with a high cardiovascular risk, only 5.2% fell into the 35-44 year age category, compared with a staggering 87% of those aged 60 and above. This is in concordance with established data [14]. Similarly, the risk was more in males than females, and in those with a positive family history, demonstrating the influence of non-modifiable risk factors in cardiovascular disease, with increasing age being a strong predictor, along with male sex and genetic predisposition [3]. All these were statistically significant. The latter two were also prevalent in a study by Jayawardena et al. [17], and the study by Ranawaka et al. [20], showed that proportion of 'high risk' increased for age and male gender. The effect of menopause, when the protective effect of oestrogen diminishes, equalizing the risk between males and females, is a potential area for further study in this population, given that the majority are elderly females, for whom the risk is higher [21]. While none of these factors can be altered, understanding their impact is essential in early diagnosis and monitoring.

As expected, those with hypertension had a high risk ($p<0.001$), reinforcing the need for early detection and intervention. It was surprising that 35.8% of those with normal BMI were at high risk compared with only 27.8% having a high BMI ($p=0.047$), but given that the villagers' livelihood involves farming and heavy manual labour, it is possible for BMI to be normal with cardiovascular risk being risk due to other contributory factors. Many other modifiable risk factors such as alcohol consumption, tobacco smoking, betel chewing and leading a sedentary lifestyle were associated with high cardiovascular risk. This highlights the importance of public health education initiatives targeting such communities in an effort to improve health literacy, leading to reduction in risk factors via lifestyle changes. There was a higher cardiovascular risk in those that did not consume unhealthy snacks which was unexpected, but could be due to the wording of the questionnaire that led to 92.5% of the respondents selecting the 'consume' option.

Those with elevated fasting blood sugar, serum creatinine and serum cholesterol had high cardiovascular risk, aligning with medical expectations [22]. This emphasizes the importance of laboratory testing, which was previously unavailable at the hospital. While there are more specific tests to assess the effect of lipid associated cardio vascular risk, such as triglycerides and high-density and low density lipoproteins, only cholesterol was offered in this programme. The three used here are widely available and still offer valuable insight in early risk identification.

Among those diagnosed with an NCD, the majority exhibited high cardiovascular risk. This underscores the importance of early detection of NCDs via screening programmes such as this, in order to identify high risk individuals, and to alter disease progression, thereby reducing the overall burden of disease.

Conclusion

In conclusion, a majority of this rural population were found to have an NCD, which illustrates that it is imperative that coverage should be increased in such regions and facilities for screening programmes be provided. A high number of risk factors were prevalent, demonstrating an epidemiological transition, which should be taken into consideration when planning preventive interventions. While the majority had low risk, the prevalence of high cardiovascular risk is similar to that in more urban areas, which is alarming and highlights the need for continuous risk assessment to prevent progression of disease. The findings following analysis showed an association between cardiovascular risk and many factors such as age, sex, family history, BMI, hypertension, smoking and laboratory findings. Notably, individuals with NCDs were more likely to fall into the high risk category. This reinforces the known link between NCDs like hypertension/diabetes/chronic kidney disease and increased cardiovascular risk. Age, hypertension, smoking and elevated FBS were strong predictors of high cardiovascular risk.

The results of this study, the first conducted in the village, with 12.1% of the population newly diagnosed with an NCD, show that there are still many similar communities that are unscreened, and not stratified for cardiovascular risk. It demonstrates the urgency for more resources to be directed towards other rural regions for detection purposes, and the implementation of preventive healthcare interventions.

List of Abbreviations

NCD: Non Communicable Disease

WHO: World Health Organization

PMCU: Primary Medical Care Unit

OPD: Out Patient Department

PSSP: Primary Healthcare Systems Strengthening Project

PHR: Public Health Record

SPSS: Statistical Package for Social Sciences

BMI: Body Mass Index

FBS: Fasting Blood Sugar

Declarations

Clinical trial number

Not applicable.

Ethics Approval and Consent to Participate

Ethical review clearance was obtained from the Postgraduate Institute of Medicine, Colombo, on 27.08.2024 (ERC/PGIM/2024/102).

This study was conducted in accordance with the principles outlined in the Declaration of Helsinki. No personal identifying details were taken, and confidentiality was maintained with regard to the data.

Consent for Publication

Not applicable.

Availability of Data and Materials

The dataset used and analysis done are available from the corresponding author upon reasonable request.

Competing Interests

The authors declare no competing interests.

Funding

This study had no funding.

Authors' Contribution

NP: Conceived the study, collected data, performed analysis and interpretation of data, and drafted the article.

DJ: Supervised the study, assisted in data analysis and interpretation, critically revised the article, and approved the final version.

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