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PSYCHOSOCIAL DISTRESS AS A RISK FACTOR OF ISCHEMIC HEART DISEASE MORTALITY

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SUMMARY

***Background**: Ischemic heart disease (IHD) is the leading cause of morbidity and mortality in the industrialized world. Recent research evidence suggests that psychosocial distress has been implicated as both a precursor to IHD and a significant risk factor for death in those with established IHD. According to WHO, psychosocial distress will be the most harmful risk factor for the development of IHD in the near future. Some experts have underlined the importance of the psychosocial distress of economic and political reforms as the main reason for the IHD mortality crisis in Russia in the 1990s. The aim of the present study was to estimate the effect of psychosocial distress on IHD mortality rate in Russia.*

***Subjects and methods:** Trends in age-adjusted, sex-specific suicide (as an integral indicator for psychosocial distress) and IHD mortality rate in Russia from 1965 to 2005 were analyzed employing a distributed lags analysis in order to assess the bivariate relationship between the two time series.*

***Results:** Time series analysis indicates the presence of a statistically significant association between the two time series for males at lags 0 and females at lags 0 and 1.*

***Conclusions:** These findings suggest that the Russian IHD mortality crisis is most likely to have been precipitated by the psychosocial distress imposed by rapid societal transformation. The experience of Russia should serve as an example of how societal-level change can influence the health of a population.*

***Key words:** ischemic - heart disease – mortality – distress - Russia*

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INTRODUCTION

Ischemic heart disease (IHD) remains the largest contributor to morbidity and mortality in Europe, accounting for 1.92 millions deaths each year (Rayner et al 2009). Over the past decades there was a trend towards a decrease in IHD mortality in Western Europe (WE) (Kesteloot et al. 2006). This trend might be the result of modification of risk factors (Nordhorn–Muller et al. 2008). Accumulated research evidence suggests that psychosocial distress has been implicated as both a precursor to IHD and a significant risk factor for death in those with established IHD (Dimsdale 2008, Greenwood et al. 1996, Hemingway & Marmot 1999, Marmot 1988, Vale 2005, Orth-Gomer et al 1993).

In a large prospective cohort study from Japan, that included 73.242 individuals with follow-up during 7.9 years self perceived stress was significantly associated with increased mortality from IHD for both men and women (Iso et al. 2002). In a prospective, population-based study of 13.280 individuals with a median follow-up of 21 years, it was found that self-reported chronic stress significantly increases the risk of suffering IHD (Ohlin et al 2004). There is growing epidemiologic evidence suggesting that individuals with high stress jobs are at increased cardiovascular risk. The results of the INTERHEART study indicate that after adjusting for age, gender, geographic region, and smoking, those who reported “permanent stress” at work or at home had >2.1 times the risk for developing myocardial infarction (Rosengren et al. 2004). The Whitehall II study found a 2.15-fold increased risk for IHD in men who experienced effort-reward imbalance, as indicated by self reports (Stansfeld et al. 2002). Similarly, IHD morbidity and mortality was predicted by work-related stress in other epidemiological studies (Artazcoz et al. 2007, Bosma et al 1998, Brunner 2004). In laboratory studies stress was a common trigger of myocardial ischemia during psychological tests among patients with stable IHD (Jang et al. 1996, May et al. 2002, Dimsdale 2008). Altogether, this research evidence suggests that psychosocial distress is an independent risk factor for IHD.

Research evidence suggests that adverse psycho-social variables usually defined as a measurement of psychosocial distress such as low socioeconomic status, lack of social support, high demand/low control at work, depression and anxiety cluster among themselves and directly correlate with the traditional IHD risk factors (Greenwood et al. 1996; Kapfhammer 2011). The results from several studies show that depression and vital exhaustion are associated with increased risk of IHD mortality (Wulsin et al. 1999, Chumaeva et al. 2010). Some authors have suggested that both severity of depression and chronicity may be important in determining IHD risk (Wulsin et al. 1999). It appears also, that lack of social support is a very strong predictor of IHD mortality. Orth-Comer and coauthors have demonstrated that low emotional support and poor social integration predicted cardiovascular death

independently of other risk factors Orth-Gomer et al. 1993). These findings provide evidence for a "buffer hypothesis" suggesting that social support acts as a buffer to the effect of stress.

There are several potential pathways for the effect of psychosocial distress on IHD morbidity and mortality. Psychosocial distress may have a direct effect on IHD mediated by means of hypothalamic-pituitary-adrenal axis activation and rapid increase in heart rate and arterial pressure causing a higher demand of oxygen in the myocardium, coronary artery vasoconstriction and reduced blood flow with resultant myocardial ischemia, transitory endothelial dysfunction and atherothrombotic activation (Merz et al. 2002, Wittstein et al. 2005, Vale 2005). Psychosocial distress may be indirectly associated with IHD mortality through unhealthy lifestyle such as binge drinking, smoking and poor self-care (Wulsin 1999).

In contrast to Western Europe, in many countries of Eastern Europe (EE) IHD mortality continues to increase (Weidner & Cain 2003, Kesteloot et al. 2006). Moreover, a dramatic increase in IHD mortality is a major cause of the health decline in EE (Nordhorn – Muller et al. 2008). The increase in deaths from IHD has been especially pronounced among middle-aged men (Rayner et al 2009). Several studies have shown that high cardiovascular mortality in EE could not be explained by traditional risk factors identified in Western countries (Perova et al. 1995, Ginter 1995). This apparent paradox has been a matter of much speculation, but is still poorly understood. Some experts have underlined the importance of the psychosocial distress of economic and political reforms as the main reason for the IHD mortality crisis in EE countries (Stone 2000, Leon & Shkolnikov 1998, Pichart et al. 2001, Kopp & Rethelyi 2004). The process of socio-economic transformation that followed after the collapse of the Eastern Bloc created conditions of anomie, loss of control over life, economic deprivation and social isolation that might undermine the health of the population. Previously, aggregate-level studies based on data from Western countries indicated that there is a clear association between economic downturns and IHD mortality. In particular, economic recession as measured by the unemployment rate has been shown to be related to an increase in IHD mortality in nine Western countries (Brenner 1987).

In his well-design study Kopp and coauthors show that a cluster of stressful psychosocial conditions (low personal income, low job security, low social support, low control at work, anomie) account for a substantial part of the variation in middle aged male and female premature cardiovascular mortality differences across Hungarian sub-regions (Kopp et al. 2006). This allowed the authors to conclude that "the invisible hand behind middle-aged men's early deaths is socioeconomic chronic stress". In a comparative study of 50-year-old men it was shown that Lithuanian men more likely to die from IHD that their Swedish counterparts despite the minimal differences in transitional risk factors. At the same time, Lithuanian men reported more signs of psychosocial distress, vital exhaustion and depression than Swedish men (Kristenson et al. 1998). The Lithuanians also had higher baseline levels of stress hormones and showed an attenuated response suggesting that they were chronically stressed. Much of the evidence supporting the idea that psychosocial distress is an "invisible hand" behind IHD mortality crisis in EE came from Russia. In a population-based study in Arkhangelsk, depression, anxiety, sleeping disorders and low quality of life had a strong positive association with cardiovascular disease after adjustment for smoking and alcohol variables (Averina et al. 2005).

However, the available data do not provide a convincing support for the stress-related hypothesis of IHD mortality crisis in EE, because the estimates of social and economic indicators of psychosocial distress are not particularly accurate and reliable (Macleod et al. 2002, Turner et al. 1995). Moreover, there is no academic consensus on the definition of psychosocial distress and, subsequently, no "gold standard" for stress indicators. Suicide rate appears to be a sensible indicator of psychosocial distress and may be used as a proxy measure in studying the effect of psychosocial distress on the health of the population (Razvodovsky 2010). In this study we will test the stress-related hypothesis of the IHD mortality crisis in Russia by analyzing aggregate-level data on suicide (as a proxy for psychosocial distress) and IHD mortality rates from 1956 to 2005.

MATERIAL AND METHODS

Data

The data on age-adjusted sex-specific suicide and IHD mortality rates per 1000,000 of the population are taken from the Russian State Statistical Committee (Rosstat). The Rosstat's cause of death classification has undergone several changes in recent decades. Until 1988 the cause of death classification was based upon the Soviet nomenclature which had a limited number of causes of death in comparison with the International Classification of Diseases (ICD) system. From 1989-1998 Rosstat used a coding scheme that was based on ICD-9. From 1999 a new coding system based on ICD-10 was introduced. Rosstat issued a table of correspondence between its classification system and ICD-9 and ICD-10 and it has been claimed that the Russian system of coding was and is compatible with the ICD. For example Soviet classification 90-95 «Ischemic heart disease " corresponds with ICD-9 code E 410-E 414 and with ICD-10 code I20-I25. Goscomstat's code 173 (1989-1998) "suicide and self-inflicted injury) corresponds with ICD-9 code E 950.0-E 959.9 and code 249 (since 1999) corresponds with ICD-10 code X 60.0-X 84.9.

Statistical analysis

The statistical analysis was conducted with the package "STATISTICA". Bivariate correlations between the raw data from two time-series can often be spurious due to common sources in the trends and due to autocorrelation (Box & Jenkins 1976). One way to reduce the risk of obtaining a spurious relation between two variables that have common trends is to remove these trends by means of a 'differencing' procedure, as expressed in the formula:

$$\nabla x_t = x_t - x_{t-1}$$

This means that the annual changes '∇' in variable 'X' are analyzed rather than raw data. The process whereby systematic variation within a time series is eliminated before the examination of potential causal relationships is referred to as 'prewhitening'. This is subsequently followed an inspection of the cross-correlation function in order to estimate the association between the two prewhitened time series. We used this technique to estimate the relationship between the time series of suicide (as a proxy for psychosocial distress) and IHD mortality rates in this paper. An unconstrained polynomial distributed lags analysis was also used to estimate the lagged relationship (i.e. to assess the lag structure) between the suicide rate as the independent variable and the IHD mortality rate as the dependent.

RESULTS

The trends in the age-adjusted, sex-specific suicides and IHD mortality rates are displayed in Figures 1-2. For both sexes the time series IHD mortality rates fluctuated greatly over the period: increasing steadily from 1956 to 1980, decreased markedly from 1980 to 1982 (by 6.6% and 8.8% for men and women respectively) before dropping sharply in the years 1984-1986 (by 24.3% for males and by 25.9% for females). Sharp increases in mortality have occurred during 1991-1994, which was followed by a steep decline between 1994 and 1998, with a new increase emerging between 1998 and 2003. Although the sex-specific IHD mortality trends are rather similar over the time series there are substantial differences. In particular, the rate of IHD mortality increased for both males and females during the transition, but it appear that males were more adversely affected during this period. From 1990 to 1994 the male CHD mortality rate increase by 38.4%, while the female rate increased by 25.9%.

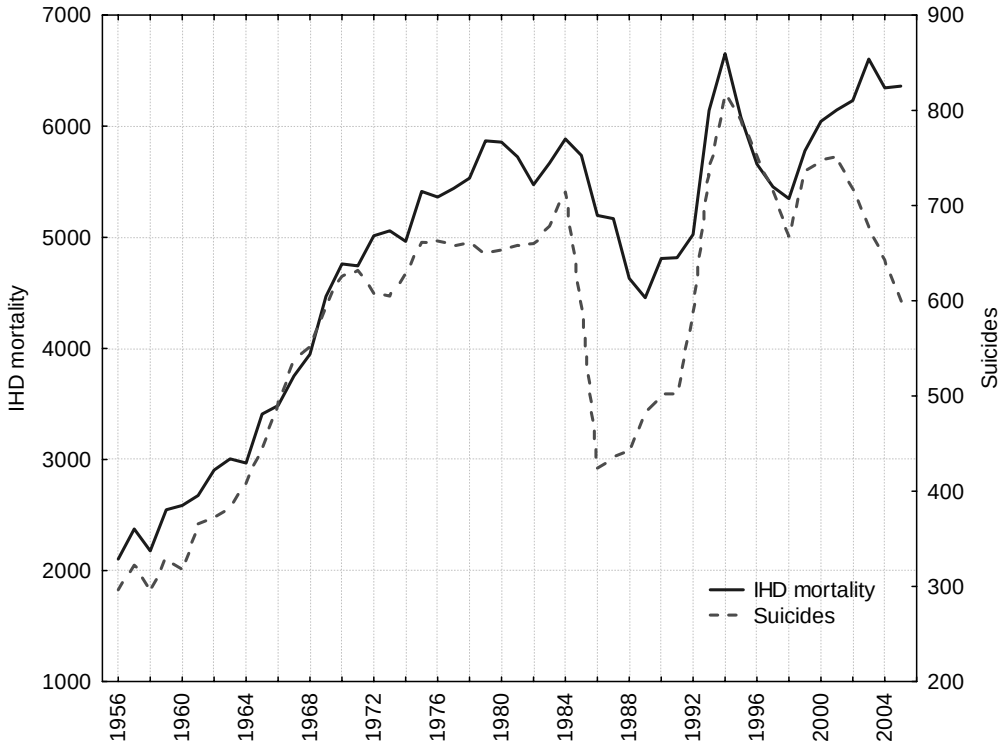

Figure 1. Trends in suicide and IHD mortality for males in Russia between 1956 and 2005

Table 1. The results of distributed lags analysis for males

Lag	Regression Coefficient	Standard Error	t	p
0	4.003	0.842	4.750	0.000
1	0.827	0.955	0.865	0.391
2	-0.250	0.938	-0.267	0.790
3	0.974	0.829	1.1740	0.246

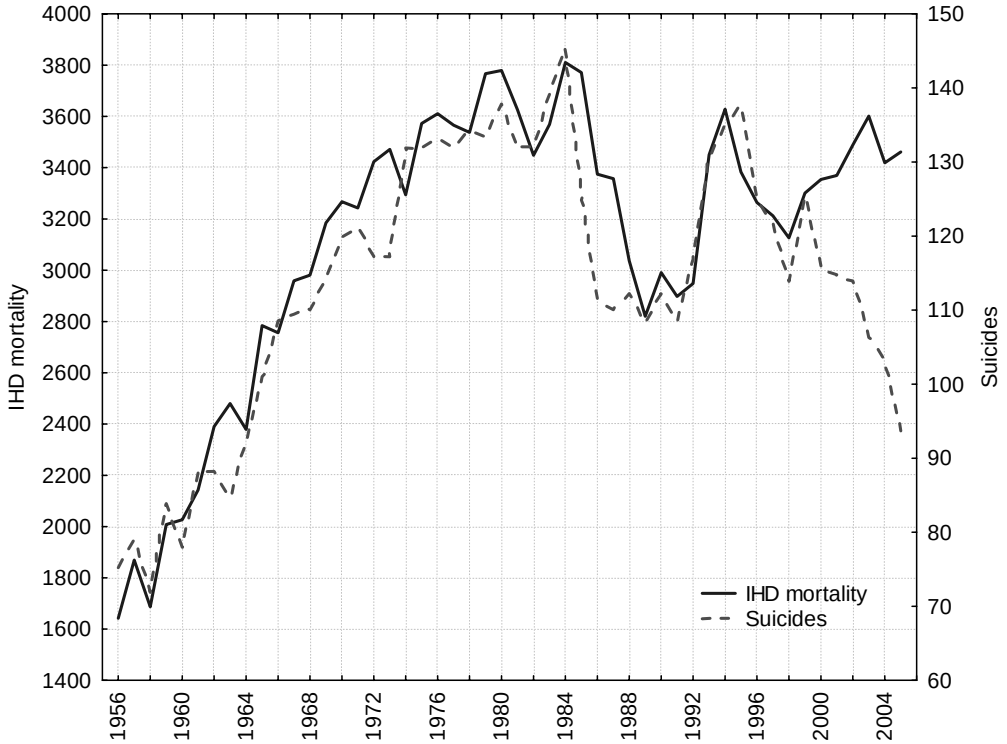

Figure 2. Trends in suicide and IHD mortality for females in Russia between 1956 and 2005

Table 2. The results of distributed lags analysis for females

Lag	Regression Coefficient	Standard Error	t	p
0	9.015	3.212	2.806	0.001
1	10.603	3.145	3.370	0.001
2	-1.033	3.108	-0.332	0.741
3	2.280	3.169	0.719	0.475

The graphical evidence suggests that the trends in both suicide and IHD mortality for males and females seem to follow each other across the time-series (Figures 1-2). As can be seen, there were sharp trends in the time series data across the study period. These trends were removed by means of a first-order differencing procedure. After prewhitening the relationship between suicides and the IHD mortality time series were inspected. This indicated that there was a statistically significant association between suicides and IHD mortality for males at lags 0 and females at lags 0 and 1 (Tables 1-2).

DISCUSSION

It seems that the CHD mortality trends in Russia influenced by the interplay of several main variables: the long-standing public health crisis that began in the mid-1960s, the Gorbachev anti-alcohol campaign in the mid-1980s, and the socioeconomic crisis in the yearly 1990s which occurred after the collapse of the Soviet Union, and the financial crisis in 1998. The most striking rises in Russian IHD mortality occurred after the collapse of the Soviet Union in 1991, which was followed by a significant increase in the level of psychosocial distress. In the early years of the transitional period Russia faced a deep socioeconomic crisis accompanied by growth in unemployment, hyperinflation and dramatic decline in the well being of the majority of the population (Leon & Shkolnikov 1998). The turmoil associated with the socioeconomic and political transition affected Russian peoples and lead to the relatively high prevalence of depression, anxiety and sleeping disorders that were strongly associated with low socioeconomic status, poor nutrition and adverse health behavior such as binge drinking and smoking (Cockerham et al. 2006, Yukkala et al. 2008). It is noteworthy that the increase in mortality in 1998-2003 also coincided with the socioeconomic crisis, while decreases in 1994-98 and 2003-2005 correlate with improvement in the economic situation. This empirical evidence may suggest that psychosocial distress is responsible for dramatic fluctuations in IHD mortality in Russia during recent decades.

Because the dramatic rise in IHD mortality in the early 1990s was preceded by a sharp decrease during the anti-alcohol campaign, many commentators relate these fluctuations to changes in alcohol availability (Nentsov & Razvodovsky 2009, Ramstedt 2009). On the other hand, several researchers argue that alcohol is

unlikely provide the universal explanation for the mortality fluctuations during the 1980s in Russia as the proportion of heavy binge drinkers in women is negligible, but the temporal changes in deaths rates were similar in men and women (Leon & Shkolnikov 1998).

In previous studies of the relationship between unemployment and IHD mortality rate the correlation was observed over a zero to six years lag, with a peak at two to three years (Brenner 1987). Brenner argues that a short-term effect within zero to one year following recession reflects the immediate shock effect of severe psychological loss on the highly vulnerable population. The basis for a two to three year peak in the psychosocial distress-IHD mortality association is that the socioeconomic situation tends to become more stressful with an increasing number of cumulative stresses. The results of present time series analysis provide evidence for an almost contemporaneous relationship between the two variables, i.e. at zero and at first lag. Therefore, we have no reason to believe that there is a lagged relationship between psychosocial distress and IHD mortality.

Gender inequality in health is a well documented phenomenon (Roeters et al. 2002). To data, no single explanation has accounted for discrepancies between male and female cardiovascular morbidity/mortality rates and despite extensive study, many unanswered questions remain (Orth-Gomer et al. 2000). It is obvious that the health inequality between men and women reflects the interplay between sex-related biological and social factors. Therefore, investigations are needed to identify determinants affecting the health of men and women and gender differences in exposure and vulnerability to them. A gender-sensitive approach to health means to distinguish the relative importance of the structural, behavioral and psychosocial determinants of health. A considerable inconsistency exists in the international literature on gender differences in the effects of psychosocial distress on cardiovascular morbidity and mortality. Many stress-related risk factors (depression social isolation, vital exhaustion) have been reported to have a greater impact on IHD progression in men compared to women (Roeters et al. 2002, Weidner & Cain 2003, Chumaeva et al. 2010). A Hungarian follow-up study found that the socioeconomic factors were related to premature mortality in men, whereas in women this association was not statistically significant (Kopp et al. 2006). Most important factors that contributed to the explanation of the relationship between socioeconomic variables and premature mortality in men were severe depression, works stress, poor lifestyle and low social support. Men were found to be more vulnerable to the socioeconomic disadvantages and effects of material deprivation and relative income inequality. Findings from Hungary also showed that women could adapt to the socioeconomic crisis more effectively (Kopp et al. 2006). Other comparative studies also revealed that women's coping with stress may be more cardio protective (Stansfeld et al. 2002).

The IHD mortality crisis in Russia during the 1990s can be considered as a natural experiment that may contribute to a better understanding of mechanisms underlying gender inequalities in mortality in a suddenly changing society. One of the most interesting features of the IHD mortality crisis in Russia in the early 1990s is the gender difference in spite of the fact that men and women share the same socio-economic circumstances. It seems that males were most vulnerable to the stressful experience resulting from abrupt socio-economic changes, political instability, unemployment and impoverishment. The differences in gender social roles might give important clues for understanding the gender gap in IHD mortality. In particularly, Gavrilova et al. (2000) suggest an explanation of the weak response of female suicide mortality to the economic crisis by a caregiver role of women in Russian society. It appears also that the social support system of men was more deeply affected by dramatic social transformation, while the close social network of women remain comparatively unchanged. The maladaptive coping strategies are likely to play an important role in the gender gap in IHD mortality in Russia during the socioeconomic crisis. Although Russian men tend to report less depression, they may be coping with depression less effectively than women (Averina et al. 2005, Bobak et al. 2006). Men are more likely to use maladaptive coping strategies, such as binge drinking and smoking that may contribute to the greater gap in IHD mortality in Russia during the socioeconomic crisis, when men are faced with the disruption of the traditional male role as a breadwinner (Cockerham et al. 2006, Yukkala et al. 2008).

It should be pointed out that in the present study the relationship between psychosocial distress and IHD mortality is much closer for women than for men. This is something that contradicts previous findings suggesting that psychosocial distress has a greater impact on IHD mortality in men compared to women (Roeters et al. 2002, Weidner & Cain 2003). This inconsistency may have several explanations, one of which is that men are more prone to respond to stressful situations with maladaptive behavior such as binge drinking (Cockerham et al. 2006, Yukkala et al. 2008). In Russia, binge drinking is a traditionally masculine behavior, and surveys show consistently higher rate of excessive drinking among men than women (Cockerham 2000). There is convincing evidence that heavy episodic or binge drinking is associated with an increased risk of IHD, while light to moderate alcohol consumption protects against the risk of cardiovascular events (Mckee & Britton 1998, Anderson 2005). Beverage preference also might be responsible for the gender difference in psychosocial distress-IHD mortality association as vodka continue to be the drink of choice for the majority of men in Russia, while women not only drink less often than men, but those who do drink, consume vodka less frequently than men (Bobak et al. 1999). This hypothesis is consistent with

the findings from a recent study highlighting the fact that of three beverages (vodka, wine and beer) vodka alone was associated with cardiovascular mortality in Russia (Razvodovsky 2010b). So, alcohol might be a powerful confounder in the psychosocial distress - IHD mortality association, especially in men.

Another source of bias may be the reliability of suicide rate as a proxy for psychosocial distress. There is strong evidence of an important role of alcohol in explaining Russian suicide mortality fluctuations (Nemtsov & Razvodovsky 2009). In the context of gender inequality it should be emphasized that the size of the bivariate association between alcohol and suicide for men is substantially greater than for women. According to recent estimates the attributable fraction of alcohol for male suicides (61%) exceeded considerably that for females (35%) (Razvodovsky 2011).

Other potential confounders, such as smoking, diet and declining standards of medical care may also contribute to both the higher background IHD mortality in Russia and its massive fluctuation during recent decades. However, none of these factors changed in Russia during the 1990s in a way that seems likely to explain the sharp increase in IHD mortality.

Before concluding, it is necessary to say something about the potential limitations of this study. In particular, there may have been potential problems with the mortality data we used. An earlier study has confirmed the reliability of the statistics on suicide death for the Soviet period (Wasserman & Varnik 1994). However, a rising rate of "injury death of undetermined intent" in the post-Soviet period may indicate declining quality in suicide mortality statistics (Varnic et al. 2009). The suicides misclassification may be the reason behind the apparent reversal in suicides and IHD mortality trends that has been seen in the most recent years.

CONCLUSIONS

In conclusion, the results of present study suggest a positive aggregate level association between suicides and IHD mortality rates in Russia between 1956 and 2005. These findings are consistent with a growing body of evidence linking psychosocial distress with IHD mortality. The outcomes of this study also support the hypothesis that psychosocial distress, which resulted from dramatic socioeconomic changes, has played a crucial role in the Russian IHD mortality crisis. Further research is needed to understand the psychosocial determinants of cardiovascular mortality crisis in EE.

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