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A Comparative Analysis of Contributing Factors and Management Approaches for Type 2 Diabetes Mellitus in the Elderly: Evidence-Based Perspectives from Malaysia and Russia

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Abstract

Background: Type 2 diabetes mellitus (T2DM) is a growing global concern, especially in aging populations. As over 95% of all diabetes cases are classified as type 2, addressing this issue among the elderly is critical for public health planning. Malaysia and Russia, two countries with differing healthcare infrastructures and socio-cultural contexts, face increasing T2DM prevalence among their senior populations. This study aims to explore regional disparities and similarities in contributing factors and management approaches to provide evidence-based guidance for improving elderly care.

Methods and Materials: This comparative study utilized a comprehensive literature review from databases such as PubMed, ScienceDirect, WHO, and national health registries from 2010 onwards. Epidemiological data, dietary and physical activity trends, socioeconomic influences, and genetic predispositions were analyzed. National management guidelines for T2DM in both Malaysia and Russia were also critically reviewed, including the Malaysian Clinical Practice Guidelines and the Russian National Diabetes Algorithms.

Results: Findings revealed that Malaysia exhibits a higher T2DM prevalence in the elderly due to urban lifestyle changes, poor dietary habits, and physical inactivity. Russia, while having a slower increase in prevalence, shows notable disparities in rural healthcare access and higher incidence among older women. Socioeconomic barriers and genetic predispositions play key roles in both regions. Malaysia emphasizes subsidized care and national registries, while Russia relies heavily on universal healthcare and medication access. Both countries face challenges in lifestyle modification adherence and equitable healthcare delivery.

Conclusion: T2DM in elderly populations requires context-specific management strategies. While Malaysia must address urban-rural disparities and promote healthier lifestyles, Russia should focus on enhancing accessibility and preventive education. Cross-country insights underscore the importance of tailored, equitable, and proactive approaches in managing T2DM among aging populations globally.

Keywords: *Type 2 Diabetes Mellitus, Elderly Population, Comparative Analysis, Healthcare Management*

Background

Diabetes represents a significant and growing public health challenge, particularly among the elderly population. It is a long-term condition that happens either when the pancreas fails to produce adequate insulin or when the body is unable to utilize the insulin it generates effectively. As the global population ages, the prevalence of diabetes among elderly individuals is increasing, necessitating a comprehensive understanding of key factors and effective management strategies. According to the World Health Organization (WHO), in 2022, 14% of adults aged 18 years and older were living with diabetes, an increase from 7% in 1990. More than half (59%) of adults aged 30 years and over living with diabetes were not taking medication for their diabetes in 2022.

Furthermore, more than 95% of people with diabetes have type 2 diabetes. Type 2 diabetes mellitus (T2DM) was formerly called non-insulin-dependent or adult onset. Until recently, this type of diabetes was seen only in adults, but it is now also occurring increasingly frequently in children (World Health Organization, 2024).

T2DM represents approximately 90% of all diabetes cases. In T2DM, the insulin reaction is reduced, and this is termed insulin resistance. In this condition, insulin loses its effectiveness and is initially balanced by increased insulin production to support glucose homeostasis; however, as time passes, insulin production declines, leading to T2DM. T2DM is most frequently observed in individuals over 45 years of age (Goyal et al., 2023).

Understanding the shared factors between the elderly in Malaysia and Russia is essential, as it allows for comparisons that provide a broader perspective on the global impact of this disease and its potential benefits. This is a crucial step before identifying and understanding the types of management offered to elderly patients based on each respective country.

Aim of study

This project aims to compare and examine the factors influencing and management approaches for Type 2 diabetes mellitus (T2DM) in elderly populations of Malaysia and Russia, emphasizing evidence-based medicine. This study aims to explore regional patterns in T2DM prevalence, investigate the influence of factors like age, socioeconomic condition, lifestyle behaviors, and genetic susceptibility, and assess healthcare systems in the two countries to pinpoint strengths and weaknesses in their T2DM diagnosis, treatment, and management methods. In the end, the research seeks to suggest improved methods for prevention and treatment, aiding regional and worldwide initiatives to tackle diabetes in older adults successfully.

Objectives

- To assess the occurrence of T2DM in older demographics in Malaysia and Russia, utilizing national and international epidemiological statistics.
- To recognize and examine the factors like age, socioeconomic standing, lifestyle choices, and genetic tendencies affecting T2DM in the elderly across both areas.
- To observe the health care systems in Malaysia and Russia, concentrating on their methods for managing T2DM among older adults and see similarities or differences in it
- To explore regional patterns in T2DM management and evaluate the success of evidence-based medical practices in both nations.
- To offer perspectives on policy suggestions that might enhance T2DM management and prevention for older adults in various environments.

Methods

All collected data are taken from relevant sources from 2010 until now through PubMed, NCBI, EMBASE, ScienceDirect, NIH, SpringerLink, The Lancet, and Elsevier. For Malaysia-

Specific information and resources like the Ministry of Health Malaysia, the Asia Pacific Journal of Public Health, and the Malaysian Journal of Nutrition. For Russia, the Diabetes Care in Russia journal, the Russian Public Health Statistics Portal, and the WHO Europe Health Database will be valuable in examining national health statistics, diabetes care policies, and public health interventions.

Practical significance

This project seeks to improve comprehension and control of Type 2 diabetes mellitus (T2DM) in elderly patients in Malaysia and Russia through a comparative examination of influencing factors and management approaches. It also aims to uncover best practices and shared challenges between the two regions by analyzing variations in lifestyle, socioeconomic factors, genetic tendencies, and healthcare systems. The results will provide evidence-backed suggestions to enhance patient outcomes, lessen complications, and optimize resource distribution in managing T2DM. Ultimately, this project aims to enhance global approaches to tackling T2DM, fostering healthcare equity, and elevating the quality of life for older adults in culturally varied environments.

Prevalence and Trends in Type 2 Diabetes Mellitus Among Elderly Populations

The World Health Organization (WHO) states that old age signifies a decline in a person's ability to adapt to their environment, which is beyond their control, and it chronologically applies to those aged 65 and above. The WHO categorizes chronological old age in the following manner: ages 65-75 are considered young, old ages, marking a transition from employment to retirement; ages 75-85 are termed advanced old ages, indicating the onset of functional declines; ages 85 and beyond are classified as very advanced old ages, which necessitate specialized care and assistance (Beğer and Yavuzer, 2012). The International Diabetes

Federation states that at least 285 million individuals globally are impacted by diabetes, and this figure is projected to rise to 438 million by 2030, with two-thirds of diabetes instances found in low- to middle-income nations. The count of adults with impaired glucose tolerance is expected to increase from 344 million in 2010 to around 472 million by 2030.

As per the estimations from the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) 2019, diabetes ranked as the eighth main cause of death and disability globally, affecting almost 460 million individuals of all ages and nationalities in 2019 (Vos et al., 2020). A T2DM poses a worldwide public health emergency that endangers the economies of every nation, especially in developing regions. Driven by swift urbanization, changes in diet, and more sedentary ways of living, the epidemic has expanded alongside the global increase in obesity (Hu, 2011).

According to Ong et al. (2023), for people aged 65 years old and above (see Figure 1), about 20% of the prevalence rate of having the disease T2DM is from Eastern Europe (Russia) and Southeast Asia (Malaysia). However, as the ages grow, a slight difference can be observed, where Russia has a lower prevalence rate than Malaysia in the age range of 80 to 90 and above.

Statistics and Trends in Malaysia

Worldwide, approximately 463 million individuals are affected by diabetes, whereas in Malaysia, it is projected that in 2019, 3.9 million (18.3%) of adults had elevated blood sugar levels. These figures are projected to increase (Chandran et al., 2020).

National Diabetes Registry (NDR). It was created to oversee the clinical results of diabetic patients treated at the Ministry of Health (MOH) community health centers. The NDR commenced in 2009 and has been observed through a web-based data-gathering system since

2011. Every patient getting diabetes treatment at involved KKs (Health Clinics) must be registered in the NDR, and the patient's condition is routinely updated. A portion of patient records undergo an audit annually, and the clinical and treatment data is recorded in NDR. This report examines and assesses the treatment, clinical outcomes, and complications in audited records of diabetes patients for 2013 - 2019 (see Table 1). Chandran, Abdullah, Abdul, and Ministry of Health, Malaysia (2020) stated that based on the registry data set, a total of 1,614,363 patients were recorded in the NDR, of which 99.3% were found to have T2DM. The average age of T2DM patients in the NDR was 63 years. The average age at which T2DM patients were diagnosed was 53 years.

Diabetes in Malaysia. Malaysia is a multicultural country where people from diverse ethnic groups, including Malays, Chinese, Indians, and various indigenous and minority communities, live together, contributing to a rich tapestry of cultural heritage and harmonious coexistence. It noted that each race contributes a percentage of the incidence of T2DM. Table 2 shows that each state contributes to a high number of cases in Malaysia. Selangor exhibits the highest Percentage of diabetes mellitus patients at 14.37%, with Malays constituting 55.50%. Johor follows with a rate of 14.13%, primarily consisting of Malays at 63.13%.
Perak ranks third in diabetes mellitus prevalence at 10.88%, with 55.07% being Malays in terms of ethnicity (see Table 2).

Age and gender-specific incidence rates for T2DM. According to Table 1, most patients were women (57.1%) and Malay (59.2%). As of 2019, there were 897,421 active diabetes patients in the NDR. From this report, we can observe that elderly age among Malaysians are at a high risk for T2DM (Chandran et al., 2020). Malaysia possesses the highest diabetes rate in the Western Pacific area and ranks among the highest in the globe, totaling

Approximately 600 million US dollars annually (Ganasegeran et al., 2020; Ganasegeran et al., 2021). The occurrence of diabetes increased from 11.2% in 2011 to 18.3% in 2019, reflecting a 68.3% rise (NHMS, 2019). A national survey report reveals that in Malaysia in 2019, there were 3.6 million adults (aged 18 and older) living with diabetes. 49% (3.7 million) of cases went undiagnosed (The Star, 2019). It is anticipated that 7 million individuals will be impacted by diabetes. By 2025, Malaysian adults aged 18 and above will face a significant public health threat due to a diabetes occurrence rate of 31.3% (NHMS, 2019). The occurrence of diabetes in Malaysia, according to released studies, varies between 7.3% and 23.8% (Harris, Ooi, Lee, & Matanjun, 2019).

In summary, Malaysia encounters a significant public health issue as the incidence of T2DM increases, especially within its elderly demographic. As of 2019, 3.9 million adults (18.3%) in Malaysia experienced high blood sugar levels, primarily comprising women and Malays. Projections indicate that by 2025, diabetes will impact 31.3% of people aged 18 and above, representing a major risk to public health. For older populations, this forecast is especially concerning as it suggests a rising burden of complications associated with diabetes, heightened healthcare needs, and diminished quality of life.

Statistics and Trends in Russia

Russia faces a growing public health challenge with the increasing prevalence of Type 2 diabetes mellitus (T2DM) among its aging population. The demographic trends in the country, featuring a large segment of the population aged 65 and over, highlight the importance of tackling this problem.

Federal Register of Diabetes Mellitus. By the close of 2016 in Russia, 4.35 million individuals (3.0% of the population) were recorded in a dispensary as diabetes mellitus (DM)

Patients, with 92% (4 million) diagnosed with type 2 diabetes mellitus (T2DM), 6% (255,000) with type 1 diabetes mellitus, and 2% (75,000) suffering from other diabetes types (Shestakova, 2017).

Diabetes in Russia. Sixty data sources from 39 European nations were utilized to produce diabetes estimates for adults in the region. Fourteen countries are participating, and the Russian Federation is one of them. International Diabetes Federation projects that diabetes prevalence (9.2%) and the number of people with diabetes (61 million) in the EUR Region will see a 13% increase by 2045 (IDF Diabetes Atlas, GLOBODIAB Research Consortium, & International Diabetes Federation, 2021). Examining the trend of T2DM incidence can aid in comprehending and managing the disease burden. Brazil, Russia, India, China, and South Africa (BRICS) form the political and economic groups of nations experiencing swift economic growth progress, with almost half of the global population. Research made by Sun et al. (2022) stated that the incidence rate of T2DM) is rapidly increasing in Brazil, Russia, India, China, and South Africa (BRICS). Aging likely drives a continued increase in the incidence and mortality of diabetes. Table 3 and Figure 2 show the trend of incidence of T2DM in BRICS (Sun et al., 2022). In 2019, BRICS had 192.58 million individuals affected by T2DM. Between 1990 and 2019, the incidence rate of type 2 diabetes within BRICS increased from 152.9 per 100,000 to 280.2 per 100,000 (Sun et al., 2022).

In 2019, the incidence rate of T2DM in Russia was at the lowest level among BRICS (191.3 per 100,000). The incidence rate of T2DM in Russia saw three years of swift increase during 2015-2019, rising from 171.2 per 100,000 in 2015 to 192.8 per 100,000 in 2017, after which the growth rate slowed post-2018 (194.0/100,000 individuals), leading to a decrease to 191.3 per 100,000 in 2019. The study arranged the incidence of T2DM into consecutive 5-year

Periods from 1990 to 1994 (median, 1992) to 2015 to 2019 (median, 2017) and 19 consecutive cohorts, including those born from 1903 to 1907 (median, 1905) to 1988 to 1992 (median, 1990) (Sun et al., 2022).

Age and gender-specific incidence rates for T2DM. Figure 3 illustrates the trends in the occurrence of T2DM in people aged 65 and older in Russia, revealing clear differences between men and women. For both sexes, the occurrence rate is highest in the age range of 60– 70 years, with females between 65 and 70 years achieving an incidence rate near 200 per 100,000 people in the latest years (2015–2019), whereas males in that age range show rates nearly 150 per 100,000. After reaching 70 years old, the incidence rates slowly decrease, with females aged 75–80 exhibiting rates of approximately 150 per 100,000 and males around 100 per 100,000. Females continually show greater incidence rates than males in this age group throughout all time frames. The information also indicates a general rise in T2DM cases across the decades, with newer periods (2015–2019) displaying greater rates than earlier years (1990– 1994). This trend highlights the increasing prevalence of T2DM among older individuals in Russia, especially those who are 65 years old and older (Sun et al., 2022).

In summary, the increasing incidence and prevalence of T2DM within Russia's senior population, especially individuals aged 65 and older, highlight the need for urgent action to tackle this escalating public health issue. The noted trends, such as elevated incidence rates among females relative to males and considerable increases in recent decades, underscore the urgent requirement for management approaches to alleviate the impact of T2DM on Russia's elderly population.

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Contributing Factors to Type 2 Diabetes Mellitus in the Elderly

Type 2 Diabetes Mellitus (T2DM) is a multifaceted condition affected by several interconnected factors, especially in older adults. The prevalence of T2DM among older adults in Malaysia and Russia underscores the significance of investigating these factors to grasp regional similarities and differences. Socioeconomic elements, such as income brackets, access to healthcare, and education levels, influence individuals' capacity to effectively handle their health. Cultural traditions and daily routines shape lifestyle and dietary habits, which play a crucial role in the risk and management of T2DM. Genetic factors and age-related biological alterations also lead to heightened susceptibility to T2DM among older individuals. Examining these factors offers an important understanding of the distinct and common difficulties encountered by older adults in Malaysia and Russia, which in turn supports the creation of more efficient, evidence-driven approaches for prevention and assistance.

Dietary and Physical Activity Patterns

A sedentary lifestyle and an unhealthy diet are evidently major risk factors for type 2 diabetes (Moore et al., 2011). Research involving 113,808 Americans conducted by Bhupathiraju et al. (2013) revealed that drinking sugar-sweetened beverages greatly heightened the risk of diabetes. Janssen (2012) discovered that lack of physical activity was the highest risk factor for both men and women in Canada. Additionally, independent of overweight or obesity, increased consumption of fried foods, snacks, and soft drinks, alongside a sedentary lifestyle, elevated the risk of T2DM, while eating fruits and vegetables offered protection (Bauer et al., 2013). Drinking larger amounts of alcohol at one time raised the risk for men and women alike (Mekary et al., 2011).

Malaysian Habits in Physical Activity and Food Intake. The rising trend in Malaysia is due to several factors, such as population growth, aging demographics, urban development, increasing obesity levels, and a lack of physical activity (Samsudin et al., 2016). Typically, rises in T2DM prevalence are also linked to inactive lifestyles, poor nutritional choices (such as diets rich in sugars, fats, and sodium), and tobacco use (Sarah et al., 2004). Asian populations exhibit the strongest link between per capita sugar intake and T2D prevalence across 165 countries, possibly indicating heightened sensitivity to glucose (Weeratunga et al., 2014). Ng, Norton, and Popkin (2009) stated that physical activity has significantly declined alongside rapid urbanization and modernization in Asian populations, compounded by dietary changes. Tee and Yap (2017) mentioned that unhealthy dietary practices and a sedentary lifestyle are the main causes of overweight and obesity, which in turn are major risk factors for T2DM. The Malaysian Adult Nutrition Surveys (MANS) are comprehensive nationwide surveys assessing the dietary intake of foods and beverages in Malaysian adults aged 18–59. According to the findings from the MANS reports of 2003 and 2014, Malaysian adults exhibited unsatisfactory intake (under 20%) of the suggested servings for the primary food categories in the Malaysian Food Pyramid 2010 for three groups: fruits, vegetables, and legumes and nuts (Table 4).
Additionally, it is concerning that the proportion of individuals consuming the advised three servings of vegetables daily declined even more in the MANS 2014 to below 10%.

According to the recent MANS 2014, the attainment of suggested servings for the cereal and cereal products as well as tubers food group was slightly under 50%. The only food groups that exceeded 50% achievement were meat, poultry, and eggs, whereas the other food groups showed moderate achievement levels ranging from 20 to 30% (Table 4) (NCCFN, 2016). Both NHMS and MANS assessed the physical activity levels in Malaysian adults. The MANS 2014

The report indicated that the rate of physical inactivity was 36.9%, which is similar to the NHMS 2015 findings that noted an overall prevalence of 66.5% among physically active adults (NHMS, 2015). Physical inactivity is common among Malaysian adults, particularly the elderly. Recent research indicates that approximately 61% of Malaysians do not engage in physical activity. The combination of a sedentary lifestyle and poor eating habits has led to increased rates of overweight and obesity, which are risk factors for T2DM (Lian, Bonn, Han, Choo, & Piau, 2016). A cross-sectional study was carried out on 199 elderly, aged between 60 and 90 years, from rural areas in the Samarahan division (Asajaya and Simunjan district), Malaysia (Saad, Lian, & Hazmi, 2021). It was specifically observed that merely 12.6% of the elderly were physically active, averaging a daily step count of 3,946 steps. This minimal amount of physical activity highlights the necessity for specific initiatives to encourage active living in older adults to reduce the risk of T2DM and other diseases linked to lifestyle (Saad, Lian, & Hazmi, 2021). In conclusion, Malaysian adults, especially older people, do not adhere to the dietary guidelines of balance and moderation for the suggested amounts of primary food groups, and they are only moderately active physically.

Russian Habits in Physical Activity and Food Intake. During the Soviet Union period, the authorities created strategies regarding what and how much food individuals should consume to guarantee the nutritional quality of their diet, and production was modified to align with these nutritional guidelines (Honkanen, 2009). Following the breakup of the Soviet Union, Russia experienced numerous economic and political transformations that significantly impacted people's lives. Introduction to many of the chronic diseases in modern societies, such as cardiovascular disease (CVD), cancer, and type 2 diabetes mellitus (T2DM), can be traced back to poor diet, poor nutrition, and physical inactivity (Roberts & Barnard, 2005). Much of Russia's

Poor health situation is related to a poor diet and ore excessive use of alcohol in combination with a low level of physical activity (Honkanen, 2009).

Studies show that the intake of fruits and vegetables among older adults in Russia is typically low, exhibiting significant gender disparities (Selivanova & Cramm, 2014). A research project examining health habits discovered that higher consumption of fruits and vegetables was positively linked to improved self-rated health in older women. However, this relationship was insignificant for men (Selivanova & Cramm, 2014). This indicates that better dietary choices may improve health, particularly for older women (Selivanova & Cramm, 2014). Maksimov, Karamnova, Shalnova, and Drapkina (2020) explained that diets high in saturated fats and low in fiber were more common among the elderly and correlated with higher T2DM incidence.

Activity levels in the elderly population of Russia are not ideal. Discussions in focus groups with participants aged 60 and older showed minimal involvement in sports and physical activities. Identified obstacles include health problems, inadequate accessible facilities, and a lack of motivation. In spite of these difficulties, participants recognized the significance of physical activity for preserving health and functional autonomy (Tanatova et al., 021). A different study highlighted that adequate physical activity greatly influences self-assessed health in both older males and females. Participating in consistent physical exercise was linked to improved health perceptions, highlighting its importance in enhancing well-being in older adults (Selivanova & Cramm, 2014). The findings indicate that low consumption of fruits and vegetables and minimal physical activity are common among the elderly in Russia. Tackling these lifestyle elements through specific interventions might boost health results and elevate the quality of life for elderly individuals in Russia.

Socioeconomic Influences

Socioeconomic status (SES) encompasses access to healthcare and information, availability of healthy foods and sports facilities, income level, education, job opportunities, and individual lifestyle choices (Cao et al., 2020).

Income and Access to Healthcare in Malaysia. In Malaysia, the possible reasons for inequity in healthcare utilization between the rich and the poor are rooted in the division of services into the public and private sectors. Private providers are most commonly located in urban areas, based on the demands of the affluent local community, thereby increasing the healthcare utilization of private providers (Bakar et al., 2019). Studies show that low-income populations in Malaysia encounter major obstacles when trying to access healthcare services. An analysis of the National Health and Morbidity Survey data spanning from 1986 to 2015 revealed that although inpatient care usage displayed a pro-poor tendency, outpatient and dental care usage began as pro-rich but progressively changed over time. This indicates that socioeconomic status (SES) affects access to healthcare, as historically, those with lower incomes have had reduced access to outpatient and dental care (Bakar et al., 2019). The financial strain of healthcare use by elderly individuals in Malaysia is significant. A nationwide study projected considerable healthcare expenses related to elderly individuals, highlighting effects on both persons and the healthcare infrastructure. Elderly individuals with lower incomes are especially at risk since high healthcare expenses can result in postponed or skipped care, negatively impacting T2DM management and results (Haron et al., 2024).

Income and Access to Healthcare in Russia. Studies show that income levels directly impact healthcare expenditure in Russia (Mareeva, 2020). A research study examining the income elasticity of healthcare expenditures revealed that wealthier households spend a

Lara ger shares their income on healthcare services and medications (Mareeva, 2020). This indicates that individuals with lower incomes might encounter financial barriers that restrict their access to essential healthcare, possibly affecting the management of chronic illnesses such as T2DM (Zazdravnykh et al., 2021). Socioeconomic disparities in Russia are seen to influence access to critical services, such as healthcare. Research has indicated that a large segment of the population feels that income inequality results in unequal access to healthcare services, potentially negatively affecting health outcomes for lower-income individuals (see Table 5) (Mareeva, 2020).

Genetic and Biological Aspects

Genetics as Risk Factor Type 2 Diabetes Mellitus in Malaysia. Asians appear to be at higher risk of developing T2DM than people of European ancestry (Chan et al., 2009). A recent study in Malaysia found that a genetic risk score (GRS) combining 62 confirmed T2DM genetic risk variants accounted for under 2% of the total T2DM risk in any of the three main ancestral groups which are Malay, Chinese, and Indian (Abdullah et al., 2015). Studies have found multiple single-nucleotide polymorphisms (SNPs) associated with T2DM in Malaysians as identified that specific SNPs were notably linked to T2DM in various ethnicities, accounting for 1.0 to 1.7% of the overall T2DM risk variance (Abdullah et al., 2015). While genetic components play a role in T2DM risk, their interplay with environmental aspects like diet and lifestyle is essential. Studies indicate that recognized genetic risk variants play a notable yet limited role in the total risk variation for T2DM among Malaysian populations, emphasizing the need to account for both genetic factors and environmental influences in strategies for disease prevention (Abdullah et al., 2017).

Genetics as Risk Factor Type 2 Diabetes Mellitus in Russia. Genetic predisposition significantly contributes to the development of T2DM among the Russian population, too (Mustafina et al., 2021). Genetic factors significantly influence the likelihood of T2DM among the Russian population. Significant genetic variants, like those in the TCF7L2 and KCNJ11 genes, have been linked to a higher risk of T2DM, influencing insulin release and glucose metabolism (Timasheva et al., 2023; Sokolova et al., 2015). Research has indicated that genetic risk scores (GRS) that merge these variants with conventional factors such as age and gender enhance the precision of T2DM risk forecasting (Kiseleva et al., 2023). Nonetheless, the relationship between genetic elements and environmental factors, including diet and lifestyle, continues to be essential for comprehending the overall risk. This underscores the necessity for an integrated T2DM prevention and management strategy in Russia, tackling genetic susceptibility and adjustable risk factors.

Management of Type 2 Diabetes Mellitus

The management of Type 2 Diabetes Mellitus (T2DM) in Malaysia and Russia shows the distinct healthcare obstacles and frameworks present in these countries. In Malaysia, management approaches emphasize public health initiatives, early identification via national screening programs, and subsidized medications offered by the Ministry of Health to enhance accessibility, especially for marginalized communities, as mentioned in the National Diabetes Registry 2020. In the meantime, Russia's strategy focuses on government-funded healthcare, providing free access to vital diabetes medications and monitoring tools as part of its Universal Health Coverage system (World Bank, 2020). Both nations encounter difficulties in tackling inequalities in healthcare accessibility, patient compliance, and lifestyle changes, highlighting the

Improved strategies must be customized to their demographic and socioeconomic contexts (Ganasegeran et al., 2020; Sun et al.,2022).

Management Protocol in Malaysia. Management's primary objectives are to enhance quality of life, minimize complications, and avert untimely death. Patients and their family members ought to be guided by recognizing and tackling issues that could lead to distress, thereby negatively impacting treatment (Ministry of Health, 2020). In Malaysia, the treatment of T2DM is mainly directed by the Clinical Practice Guidelines (CPG) for the Management of Type 2 Diabetes Mellitus (6th Edition), issued by the Ministry of Health Malaysia in 2020, and the management is as follows:

- In the elderly with T2DM and established complications, intensive control reduces only the risk of microvascular events but not macrovascular events or mortality (Turnbull et al., 2009).
- Postprandial glucose (PPG) values have been shown to be a better predictor of outcomes in elderly patients compared to HbA1c or pre-prandial glucose values (Raz et al., 2011).
- Plasma glucose and capillary plasma glucose should be used instead. The principle for choice of various oral glucose-lowering drugs (OGLDs):
  - Sulphonylureas (SUs) should be used with caution because of the risk of severe or fatal hypoglycemia.
  - The risk of hypoglycemia increases exponentially with age and is higher with glibenclamide than with gliclazide and glimepiride (Shorr et al., 1997).
  - Glibenclamide is not recommended for use in patients with T2DM >60 years of age.

- Optimal nutrition and protein intake (at least 1.5 g/kg/d - 15%-20% of the total caloric intake), regular exercise with resistance training may be instituted to increase muscle strength and quality to prevent sarcopenia (Villareal, Chode, Parimi, et al., 2011).

Treatment de-escalation or discontinuation should be considered once organ failure develops or end-of-life care is initiated (International Diabetes Federation, 2013). Other comorbidities should also be treated as goals. Lipid-lowering therapy and aspirin therapy may benefit those with life expectancies at least equal to the time frame of primary or secondary prevention trials. Table 6 shows the guidelines from CPG about the characteristics of patients in relation to life expectancy and values of the HbA1C goal for determining the lipid therapy of elderly patients in Malaysia. It shows that a better prognosis is only for longer life expectancy when the treatment is done early.

Management Protocol in Russia. The National Russian Guidelines for Type 2 Diabetes Mellitus (T2DM) highlight a holistic strategy, beginning with lifestyle changes that consist of a low-carbohydrate, low-calorie diet and a minimum of 150 minutes of moderate aerobic activity weekly (Shestakova et al., 2023). Pharmacotherapy is customized to meet the specific needs of each patient, with metformin suggested as the initial treatment option (Shestakova et al., 2023). When glycemic goals are not achieved, combination therapies involving agents such as GLP-1 receptor agonists, SGLT-2 inhibitors, DPP-4 inhibitors, or sulfonylureas are implemented. At the same time, insulin is saved for more serious situations, including HbA1c levels exceeding 9% or symptomatic hyperglycemia (Shestakova et al., 2023). Monitoring requires regular self-checks of blood glucose levels and quarterly evaluations of HbA1c (Shestakova et al., 2023). The recommendations emphasize prompt modifications in treatment and the implementation of contemporary drugs while tackling accessibility issues. The "Algorithms for Specialized Medical

Care for Patients with Diabetes Mellitus" authored by Dedov et al. (2017), offers a comprehensive guideline for treating Type 2 Diabetes Mellitus (T2DM) in Russia, which is as follows:

- Diagnosis and Risk Assessment
  - A diagnosis determined by fasting plasma glucose levels of ≥7.0 mmol/L, HbA1c levels of ≥6.5%, or a 2-hour oral glucose tolerance test (OGGT) results of ≥11.1 mmol/L.
  - Risk assessment is used to detect complications or comorbidities, such as cardiovascular issues and nephropathy.
- Lifestyle Changes
  - Nutritional modifications include customized meal planning featuring regulated caloric consumption and macronutrient allocation, prioritizing foods with a low glycemic index.
  - Physical activity promotes consistent aerobic and strength training exercises customized to the patient's health condition.
  - Weight control can be achieved by focusing on weight reduction plans for overweight people to enhance insulin sensitivity.
- Drug Treatment
  - First-line treatment using metformin should be the primary medication unless there are contraindications.
  - An alternative option is sulfonylureas, as it is popular because of cost-efficiency but with careful attention to hypoglycemia dangers.

- DPP-4 inhibitors or GLP-1 receptor agonists for individuals with obesity or heart disease.
- SGLT-2 inhibitors can be given priority for individuals with chronic kidney disease or heart failure.

- Insulin Treatment:
  - Basal insulin for individuals not responding to oral treatments or experiencing severe hyperglycemia.
  - Intensive insulin protocols for advanced disease or complications case

Evidence-Based Comparative Analysis

This part assesses the information collected from Malaysia and Russia related to the prevalence of T2DM, its contributing factors, and management approaches in older adults. Comparative results underscore variations in healthcare systems, genetic factors, socioeconomic statuses, and lifestyle elements, illustrating unique regional obstacles and approaches. For example, although Malaysia shows a greater occurrence rate of T2DM due to urbanization and eating patterns, Russia emphasizes lifestyle changes impacted by its aging populace and economic inequalities. These differences highlight the necessity for interventions tailored to specific regions to effectively tackle T2DM.

Key Findings and Insights

Trends in Prevalence. Malaysia shows a greater prevalence of T2DM in older adults, primarily due to lifestyle and dietary factors. Conversely, Russia exhibits a more gradual increase in prevalence thanks to proactive screening efforts, yet it encounters difficulties in rural healthcare accessibility.

Genetic and Economic Factors. Both countries encounter genetic factors, yet their varying socioeconomic conditions influence healthcare accessibility and results. Malaysia faces challenges with healthcare differences between urban and rural areas, while Russia grapples with disparities in income.

Management Approaches. Malaysia's guidelines focus on national registries and healthcare subsidies, whereas Russia largely depends on universal healthcare and personalized medication strategies.

Recommendations for Future Research and Healthcare Policies

Encourage Fairness in Healthcare Accessibility. Guaranteeing fair access to healthcare is essential for controlling T2DM in older adults. Malaysia needs to concentrate on tackling urban-rural inequalities by introducing mobile clinics and telemedicine services. In contrast, Russia should emphasize lowering financial obstacles through subsidies for diabetes drugs and complimentary glucose monitoring devices. Enhancing the accessibility and affordability of healthcare will greatly enhance diabetes results in disadvantaged communities.

Enhance Protective Steps. Programs aimed at prevention that are customized to the cultural and socioeconomic context of each country are crucial. Malaysia might gain from initiatives to lower high-carbohydrate diets and endorse well-balanced meals. In contrast, Russia should promote a decreased intake of saturated fats and processed products. Programs that encourage older adults to embrace healthier eating habits and participate in regular exercise are essential for lowering the incidence of T2DM.

Innovative Healthcare Strategies. Introducing innovative healthcare delivery methods, such as community-centered diabetes care centers and telehealth services, can address the challenges older populations face in both countries. These models improve accessibility and convenience, especially for rural or mobility-limited patients, and enhance disease management through continuous digital health monitoring and remote consultations.

Conclusion

The comparative study of Type 2 diabetes mellitus (T2DM) in Malaysia and Russia offers important insights into the occurrence, associated risk factors, and treatment approaches for older adults in these nations. Malaysia is facing issues arising from swift urban growth, changes in diet, and a rise in sedentary habits, all of which add to the escalating burden of T2DM. Conversely, Russia encounters considerable differences in healthcare availability, especially between the city and the countryside, along with lifestyle shifts affected by its aging demographic and economic conditions.

To successfully tackle T2DM among older adults, evidence-driven strategies should be customized to meet the distinct challenges of each nation, emphasizing prevention, timely diagnosis, and fair healthcare access. Joint international research initiatives and the exchange of knowledge can improve prevention and treatment methods by leveraging effective models from different areas. In the end, tackling T2DM in older populations necessitates a comprehensive strategy combining healthcare enhancements, supportive societal frameworks, and effectively designed policy measures to guarantee lasting and significant results.

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Tables

Table 1

[Characteristic of Patients enrolled in National Diabetes Registry, 2019]

Variable	n	%
Sex		
Male	692,595	42.90
Female	921,768	57.10
Total	1,614,363	100.00
Ethnicity		
Malay	954,938	59.15
Chinese	316,758	19.62
Indian	212,681	13.17
Others	129,986	8.05
Total	1,614,363	100.00
Age Group (at enrollment years)		
<18	5,030	0.31
18-19	2,524	0.16
20-24	10,402	0.64
25-29	26,923	1.67
30-34	56,439	3.50
35-35	99,400	6.16
40-44	162,277	10.05
45-49	227,109	14.07
50-54	277,844	17.21
55-59	267,850	16.59
60-64	205,301	12.72
65-69	137,012	8.49
70-74	79,966	4.96
75-79	38,448	2.38
>80	17,838	1.11
Total	1,614,363	100.0
Type of diabetes		
Type 2	1,602, 882	99.29
Type 1	10,086	0.62
Others/Unknown	1,395	0.09
Total	1,614,363	100.0

Table 2

[Characteristics of Diabetes Patients enrolled in National Diabetes Registry, 2019, by state]

	No. of patients, n (%)	Male,	Mean age	Ethnicity				
State		n (%)	(95%CI)	Malays	Chinese	Indian	Other Malaysian	Foreigners/ Unknown
Johor	228,166 (14.13)	99,117 (43.44)	63 (63.0-63.1)	144,054 (63.13)	54,993 (24.10)	27,438 (12.03)	859 (0.38)	822 (0.36)
Kedah	150,087 (9.29)	62,313 (41.51)	61 (61.3-61.4)	116,260 (77.46)	15,425 (10.27)	16,526 (11.01)	52 (0.03)	1,824 (1.22)
Kelantan	63,622 (3.94)	24,168 (37.98)	63 (63.0-63.2)	60,231 (94.67)	2,499 (3.93)	317 (0.49)	16 (0.03)	559 (0.87)
Melaka	88,226 (5.46)	39,102 (44.32)	64 (63.8-64.0)	60,421 (68.48)	18,266 (20.70)	8,860 (10.04)	122 (0.14)	557 (0.63)
Pahang	95,008 (5.88)	41,429 (43.60)	63 (62.5-62.7)	71,816 (75.58)	14,531 (15.29)	7,710 (8.11)	490 (0.52)	461 (0.48)
Perak	175,762 (10.88)	77,538 (44.11)	64 (64.0-64.1)	96,808 (55.07)	41,138 (23.41)	36,383 (20.70)	601 (0.34)	832 (0.47)
Perlis	30,114 (1.86)	12,426 (41.26)	62 (62.1-62.4)	25,967 (86.22)	2,694 (8.95)	650 (2.16)	30 (0.09)	773 (2.56)
Pulau Pinang	88,272 (5.5)	39,558 (44.81)	64 (64.3-64.5)	38,903 (44.07)	32,579 (36.90)	16,279 (1.84)	53 (0.06)	458 (0.52)
Sabah	48,915 (3.03)	21,432 (43.81)	61 (60.8-61.0)	2,296 (4.69)	10,276 (21.01)	398 (0.81)	30,444 (62.23)	5,501 (11.24)
	(3.03)	(43.81)	(60.8-61.0)	(4.69)	(21.01)	(0.81)	(62.23)	(11.24)
Sarawak	160,587	64,840	62	41,512	39,260	648	77,515	1,652
Selangor	232,054 (14.37)	101,282 (43.64)	62 (62.0-62.1)	128,799 (55.50)	41,576 (17.92)	58,552 (25.23)	732 (0.32)	2,395 (1.03)
Terengganu	63,593 (3.93)	24,669 (38.79)	61 (61.1-61.2)	62,120 (97.68)	1,257 (1.97)	75 (0.12)	17 (0.03)	124 (0.19)

WP Kuala Lumpur	67,328 (4.17)	29,684 (44.08)	64 (64.3-64.5)	30,901 (45.89)	21,533 (31.98)	14,046 (20.86)	147 (0.22)	701 (1.04)
WP Labuan	3,836 (0.23)	1,592 (41.50)	58 (57.9-58.7)	1,828 (47.65)	559 (14.57)	41 (1.07)	1,174 (30.60)	234 (6.10)
WP Putrajaya	8,202 (0.50)	4,174 (50.89)	57 (57.1-57.6)	7,539 (91.91)	242 (2.95)	351 (4.28)	38 (0.46)	32 (0.39)
Malaysia	1,614,363 (100)	692,595 (42.90)	63 (62.7-62.8)	954,938 (59.15)	316,758 (19.62)	212,681 (13.17)	112,661 (6.97)	17,325 (1.07)

Table 3

[Time trends in type 2 diabetes mellitus incidence across the BRICS from 1990 to 2019: an age-period-cohort analysis]

		BRICS		**Brazil**		**Russia**		**India**		**China**		**South Africa**	
			2019	1990	2019	1990	2019	1990	2019	1990	2019	1990	2019
Population	Total, nx 1,000,000	2376.0	3232.	148.8 (138, 159)	216.7 (190, 243)	151.0 (139, 163)	146.7 (129, 165)	855.6 (792,, 919)	1390.7 (1238 1559)	1183.7 (1103 1272)	1422.4 (1239 (33, 1597)	36.8 41)	55.6 (49, 63)
	Percentage e of global	44,4	41.8	2.8	2.8	2.8	1.8	16	18	22.1	18.4	0.7	0.7
T2DM	Incidence rate per 100,000	152.9	280.2	182.2	304.6	116.9	191.3	143.4	302.5	160.7	262.9	148.3	306.1

Note: The data corresponding to the BRICS data bar is the sum of the Brazil, Russia, India, China, and South Africa data.

Table 4

[Percentage of the population meeting the recommended servings for each food group in the Malaysian Food Pyramid 2010 as reported in MANS 2003 and 2014]

Food Group	Malaysian Food Pyramid 2010recommendation No. of servings /day	Meet recommended servings (96)(MANS 2003)	Meet recommended servings (96)(MANS 2014)
Cereal, cereal products, and tubers	4-8	52.9	41.3
Fruits	2	17.0	14.9
Vegetables	3	13.9	7.9
Meat, poultry, and egg	1/2/2-2	52.4	66.8
Fish and fish products	1	20.6	31.3
Legumes and nuts	1/2/2-1	12.3	17.1
Milk and dairy products	1-3	21.9	24.4

Table 5

[Most painful inequalities in the eyes of Russians, 2018, %]

Types of inequality	Painful for society	Painful for respondents themselves
Income inequality	83.8	69.4
Inequality of access to medical care	**69.6**	**51.2**
Inequality of living conditions	64	36
Inequality of access to good jobs (for working population)	51.9	37.5
Inequality of access to education	47.7	22.5
Inequality of opportunities for children from different social groups	32.6	19
Inequality of available leisure activities	22.4	27
Inequality of property ownership	19.5	15.6
Inequality in social capital	8.8	10.1
None	1.5	9.3

Table 6

[Treatment goals for glycemia, BP, and dyslipidemia in elderly with T2DM.]

Patient characteristics / health status	Rationale	Reasonable HbA1c goal	Plasma glucose targets (mmol/L)	BP (mm Hg)	Lipids
Healthy (few coexisting chronic illnesses, intact cognitive and functional status)	Longer life expectancy	≤7.5	Fasting: 5-7.2 Pre-bed: 5.0-8.3	<140/90	Statins treatment, as long as tolerated.
Complex/ intermediate (multiple coexisting chronic illnesses* or mild-to-moderate cognitive and functional impairment)	Intermediate life expectancy, high treatment burden, hypoglycemia vulnerability, fall risk	<8.0	Fasting: 5-8.3 Pre-bed: 5.6-10	<140/90	
Very complex/ poor health (long-term care or end-stage chronic illnesses** or moderate-to-severe cognitive and functional impairment)	Limited life expectancy makes benefit uncertain	<8.5	Fasting: 5.6-10 Pre-bed: 6.1-11.1	<150/90	Individualized. Consider likelihood of benefits of statins, especially for 2° prevention

*Note: A lower HbA1c goal may be set for an individual if achievable without recurrent or severe hypoglycemia or undue treatment burden. * Coexisting chronic illnesses are conditions serious enough to require medications or lifestyle management and may include debilitating arthritis, cancer, congestive heart failure, depression, emphysema, falls, hypertension, incontinence, stage 3 or worse DKD, MI, and stroke. "Multiple" means ≥3, but many patients may have ≥5. ** The presence of a single end-stage chronic illness, such as stage 3–4 congestive heart failure or oxygen-dependent lung disease, DKD requiring dialysis, or uncontrolled metastatic cancer,*

significantly reduces life expectancy. Adapted from American Diabetes Association Standards of Medical Care Diabetes 2020.

Figures

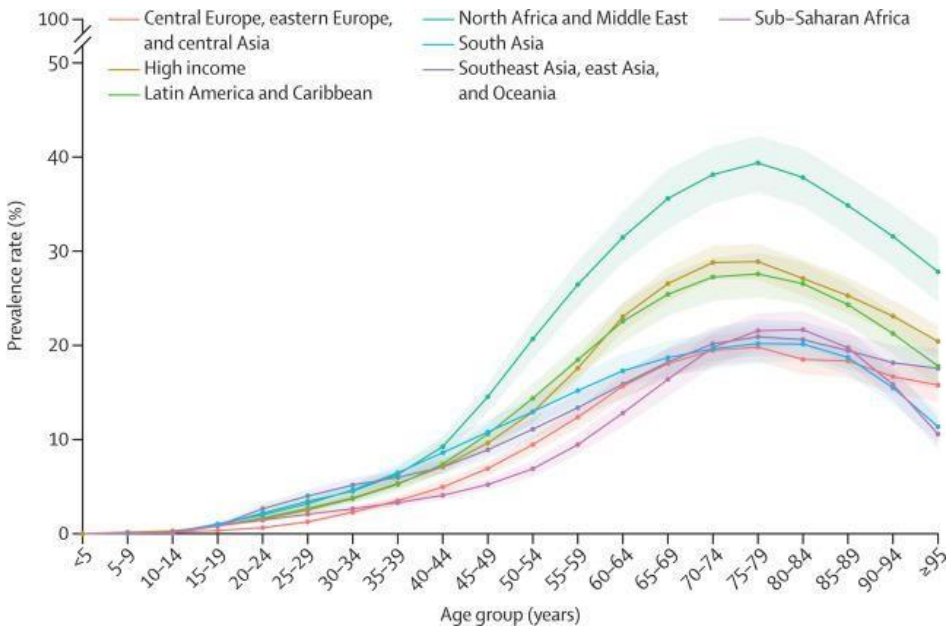

Figure 1. Prevalence of total diabetes by age and GBD super-region in 2021

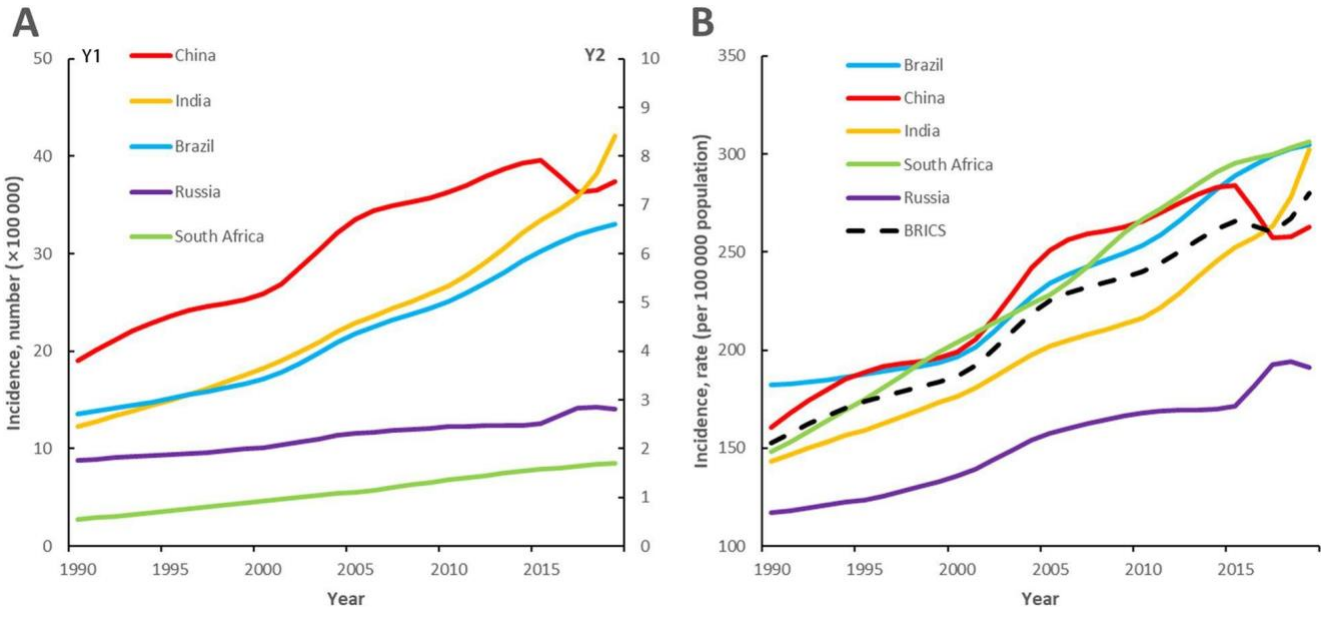

Figure 2. Number o f new o2DM and incidence rate of T2DM across Brazil, China, India, Russian Federation, and South Africa between 1990 and 2019.

Note: (A) Y2 axis for Brazil, Russia, and South Africa

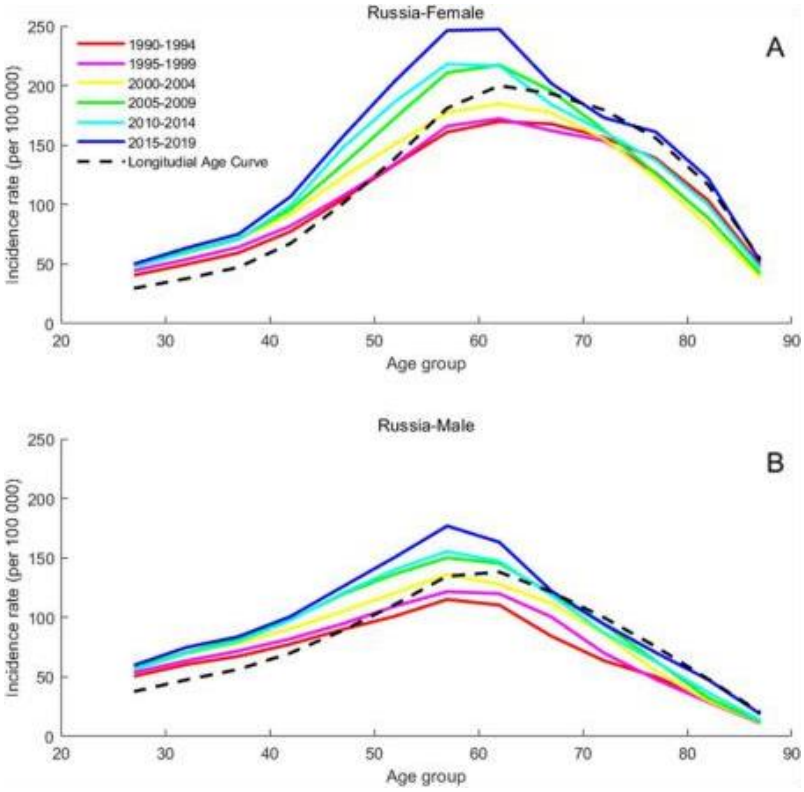

Figure 3. Age-specific incidence rates of T2DM by period in Russia between 1990 and 2019.