

Physical Activity Levels and Their Correlation with Type 2 Diabetes in Middle-Aged Chinese Women

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Abstract

This paper explores the relationship between physical activity levels and Type 2 diabetes among middle-aged women in China, with a focus on the long-term health and economic benefits of increased physical activity. Physical activity is a key factor in managing blood glucose levels and reducing the risk of diabetes, but it is only one of many contributing factors. Genetics, poor diet, and obesity also play significant roles in diabetes development, particularly when combined with low physical activity. The study examines current public health initiatives in China, such as government-led campaigns aimed at encouraging physical activity, and suggests strategies for improving activity levels through urban design, community programs, and technological interventions. Long-term benefits for both individuals and the healthcare system are also discussed, including reduced healthcare costs and improved quality of life. Finally, future research areas, particularly longitudinal studies assessing the impact of physical activity on diabetes over time in Chinese populations, are identified.

Keywords: physical activity, type 2 diabetes, middle-aged women, China, genetics, public health strategies, obesity, healthcare costs

1. Prevalence of Type 2 Diabetes Among Middle-Aged Chinese Women

Over the past two decades, China has witnessed a sharp increase in the prevalence of Type 2 diabetes, particularly among middle-aged women aged 40 to 60. This demographic has become one of the most affected by this chronic condition, which is primarily driven by lifestyle changes and the aging process. In 2005, around 8% of middle-aged women in China were diagnosed with Type 2 diabetes, but by 2020, this figure had nearly doubled to 15%. This rapid rise is alarming and highlights a broader public health challenge that China must

confront as its population ages.

One of the main factors contributing to this increase is the shift in lifestyle patterns, especially in urban areas. As China continues to urbanize, middle-aged women are increasingly adopting more sedentary lifestyles due to shifts in their professional and domestic roles. Many women in this age group are now part of the workforce, often sitting for long hours in offices with limited opportunities for physical activity. At the same time, the shift in dietary habits—from traditional, nutrient-rich meals to more processed, calorie-dense foods—has exacerbated the risk of obesity and metabolic

disorders, both of which are significant risk factors for Type 2 diabetes. This change in lifestyle, combined with the natural metabolic changes women experience during menopause, including hormonal fluctuations that can affect insulin sensitivity, places them at higher risk for developing the disease.

Another contributing factor is the increasing consumption of sugar and refined carbohydrates, which has become more prevalent in Chinese diets over the years. These dietary changes have led to higher rates of obesity, which is strongly associated with insulin resistance and the development of diabetes. Figure 1 provides a visual representation of the rising trend in the prevalence of Type 2 diabetes among middle-aged women in China from 2005 to 2020. The steady upward trajectory indicates that the issue is not temporary but rather a growing epidemic that must be addressed.

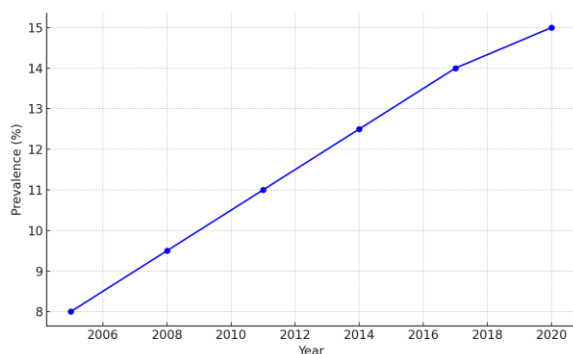


Figure 1. The increasing prevalence of Type 2 diabetes in middle-aged women in China from 2005 to 2020

The figure shows a clear and steady rise in the prevalence of Type 2 diabetes over a 15-year period. The percentage of women aged 40 to 60 diagnosed with the disease increased from approximately 8% in 2005 to nearly 15% by 2020. This upward trend reflects the urgent need for public health interventions targeting this vulnerable demographic.

China's aging population is another critical factor in the growing prevalence of Type 2 diabetes. By 2050, it is expected that more than 30% of China's population will be over the age of 60, further emphasizing the need to address age-related diseases such as diabetes. Middle-aged women are particularly vulnerable as they transition through menopause, a period characterized by hormonal changes that can affect insulin production and sensitivity. This

biological factor, coupled with lifestyle changes, makes this age group a focal point for studying diabetes trends and developing targeted interventions.

Urbanization has also played a significant role in shaping the health outcomes of middle-aged women. The migration of people from rural to urban areas has resulted in lifestyle modifications, including decreased physical activity, higher stress levels, and the adoption of unhealthy eating habits. The urban environment often lacks the infrastructure that encourages physical exercise, such as parks and safe walking spaces, which further discourages regular physical activity among middle-aged women. In addition, women who work in urban environments often face high levels of stress, which has been linked to an increased risk of developing Type 2 diabetes due to its effects on hormone regulation and insulin sensitivity.

The importance of studying Type 2 diabetes within the broader context of China's aging and urbanizing population cannot be overstated. Middle-aged women are not only at higher risk of developing diabetes due to biological and lifestyle factors but also play a central role in their families and communities. Many women in this age group are caregivers for both their aging parents and their own children, placing them in a unique position where their health has a direct impact on multiple generations. Understanding the factors contributing to the rise in diabetes among this group is crucial for developing public health strategies that not only target diabetes prevention but also improve overall family health.

Figure 1, depicting the continuous rise in diabetes cases among middle-aged women, underscores the urgency of addressing this issue through public health campaigns, policy reforms, and community-based interventions. As the prevalence of diabetes continues to grow, the strain on China's healthcare system is expected to increase. Without effective interventions, the healthcare costs associated with managing diabetes and its complications will continue to rise, placing an even greater burden on the country's economic resources. Additionally, the quality of life for these women could be significantly impacted if preventive measures are not put in place.

Thus, it is essential to focus on preventive measures, such as promoting physical activity,

improving dietary habits, and providing access to regular health screenings. These strategies can help reduce the incidence of Type 2 diabetes and mitigate the long-term health and economic consequences associated with the disease. By understanding the trends and contributing factors to the rise of diabetes among middle-aged women, healthcare providers and policymakers can implement targeted interventions that will not only address the current epidemic but also prevent future cases.

2. The Physiological and Clinical Impact of Physical Activity on Diabetes Management

2.1 Physiological Mechanisms Linking Physical Activity to Improved Glucose Metabolism

Physical activity has a profound and well-documented effect on the body's ability to manage glucose levels, particularly in individuals with or at risk of developing Type 2 diabetes. Engaging in physical activities—whether moderate aerobic exercises like brisk walking or jogging, or high-intensity resistance training—causes muscles to contract, which increases their demand for energy. To meet this demand, the muscles take up more glucose from the bloodstream, even without relying on insulin. This glucose uptake independent of insulin during exercise helps lower blood sugar levels, a crucial factor in preventing and managing Type 2 diabetes.

Furthermore, regular physical activity boosts the body's insulin efficiency. Insulin is responsible for facilitating glucose absorption by cells. In Type 2 diabetes, cells become less responsive to insulin, resulting in insulin resistance. However, physical activity improves insulin sensitivity, meaning that after exercise, the body requires less insulin to achieve the same glucose-lowering effect. This reduced demand for insulin helps decrease strain on the pancreas, which plays a key role in insulin production.

The key processes involved in this mechanism include:

- 1) Increased Glucose Uptake: Exercise promotes the movement of glucose transporters (GLUT4) to the muscle cell membranes, allowing glucose to enter muscle cells more efficiently and lowering blood glucose levels.
- 2) Enhanced Insulin Sensitivity: After exercise, muscle cells respond better to insulin, which allows the body to

regulate blood glucose with smaller amounts of insulin. This is particularly beneficial for individuals with insulin resistance.

2.2 Clinical Evidence Demonstrating the Effectiveness of Regular Exercise

Extensive clinical research validates the significant benefits of physical activity in managing Type 2 diabetes. Studies conducted across various populations, including middle-aged women in China, indicate that regular physical activity greatly improves blood glucose control. Engaging in at least 30 minutes of moderate aerobic activity five times a week has been associated with a reduction in HbA1c levels by up to 1%. HbA1c is a key indicator of long-term glucose control, and even modest reductions are linked to a lower risk of diabetes-related complications.

In a notable study involving middle-aged women in China, participants who engaged in regular aerobic activities such as cycling and brisk walking, combined with resistance training, showed marked improvements in blood glucose control and overall metabolic health. This included reductions in triglyceride levels, improved cholesterol profiles, and lower blood pressure—all of which are crucial for mitigating diabetes complications.

Additionally, physical activity has been shown to reduce the need for diabetes medications. For those in the early stages of Type 2 diabetes, consistent physical activity can delay or prevent the need for insulin therapy by helping maintain better blood glucose control. Physical exercise also supports weight management, which is vital for middle-aged women at risk of diabetes. Even a modest 5–10% reduction in body weight, achieved through exercise, can significantly improve insulin sensitivity and glucose metabolism.

Moreover, exercise offers benefits beyond glycemic control. It plays a crucial role in reducing the risk of cardiovascular diseases, which are common among individuals with Type 2 diabetes. Regular physical activity improves cardiovascular health by lowering blood pressure, enhancing heart function, and promoting healthier cholesterol levels.

In conclusion, the clinical evidence highlights the indispensable role of physical activity in the management of Type 2 diabetes. Both aerobic and resistance exercises are essential for

improving insulin sensitivity, regulating blood glucose levels, and preventing the long-term complications associated with diabetes. These findings underscore the importance of integrating physical activity into the daily lives of middle-aged women as a key preventive measure.

3. Physical Activity Levels in Urban and Rural Settings

3.1 Analysis of Physical Activity Trends Among Middle-Aged Women in Urban Versus Rural Areas

The physical activity levels of middle-aged women in China differ significantly between urban and rural areas due to contrasting lifestyle patterns and environmental factors. In urban areas, the prevalence of a sedentary lifestyle is much higher, largely driven by the nature of employment. Many women work in office environments where prolonged sitting is common, leading to reduced physical activity. Studies show that women in cities are less likely to engage in regular exercise due to time constraints, longer commuting times, and demanding work schedules. Additionally, urban

environments often lack sufficient green spaces or easily accessible recreational facilities, further limiting opportunities for physical activity.

Conversely, in rural areas, middle-aged women generally maintain higher levels of physical activity, much of which is related to daily labor such as farming, household chores, and active transportation (e.g., walking or cycling to nearby locations). These natural forms of physical activity help rural women stay more active overall, although formal, structured exercise is less common. However, even in rural areas, there has been a noticeable decline in physical activity due to modernization, mechanization in agriculture, and easier access to transportation, which reduces the need for manual labor.

The differences between urban and rural physical activity levels can be visualized in Figure 2, which compares average physical activity levels in urban and rural settings. As depicted, rural women typically engage in more physical activity, while urban women show higher levels of sedentary behavior.

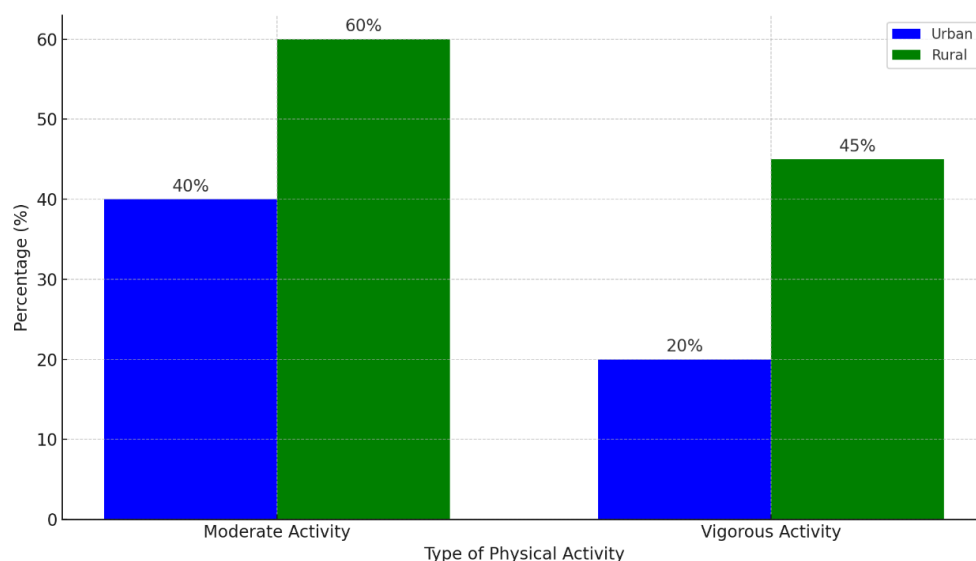


Figure 2. Physical activity levels between urban and rural middle-aged women in China

The bar chart highlights the stark differences in activity levels, with rural women engaging in more physically demanding tasks compared to urban women, who are generally more sedentary due to work and lifestyle factors.

3.2 Cultural, Environmental, and Economic Factors

Several factors influence physical activity levels in both urban and rural areas. In urban settings, the fast-paced lifestyle is one of the most

significant factors. The demands of work and family life often leave little time for exercise, and many middle-aged women prioritize work or family responsibilities over personal fitness. Additionally, the urban infrastructure does not always support an active lifestyle. In many Chinese cities, green spaces or parks are scarce, and the availability of gyms or fitness centers can be limited. Even when such facilities exist,

the cost of gym memberships or fitness classes can be prohibitive for many women.

Economic factors also play a major role. In cities, women with higher incomes may have more access to recreational activities or private fitness centers, while lower-income women may face additional barriers such as longer working hours or multiple jobs, limiting their available time for exercise.

In rural areas, cultural expectations and norms tend to shape physical activity patterns. While rural women are often more active due to their involvement in agricultural work or household chores, formal exercise is less common. Cultural norms in some rural communities may discourage women from participating in recreational physical activity or sports, and there is often limited social support for these activities. Additionally, rural areas typically lack the necessary infrastructure, such as fitness centers or sports programs, which could otherwise encourage regular exercise.

The challenges presented by both environments—urban and rural—underscore the need for tailored public health strategies aimed at increasing physical activity levels. Programs promoting exercise should consider the unique barriers faced by middle-aged women in different environments, addressing not only physical access to exercise facilities but also cultural and economic constraints.

This comparative analysis of urban and rural physical activity levels, supported by Figure 2, highlights the importance of understanding these variances in order to create more effective interventions that can help women in both settings achieve healthier, more active lifestyles.

4. Key Risk Factors for Type 2 Diabetes Beyond Physical Activity

4.1 Interaction of Genetics, Poor Diet, and Obesity with Low Physical Activity Levels

While physical activity is a significant factor in managing and preventing Type 2 diabetes, it is only one piece of a larger puzzle. Several other risk factors, such as genetics, poor diet, and obesity, interact with low physical activity levels to increase the likelihood of developing Type 2 diabetes in middle-aged women, particularly in China.

Genetics plays a crucial role in determining an individual's predisposition to Type 2 diabetes. Women with a family history of diabetes are

more likely to develop the condition themselves, especially if other risk factors are present. Genetic predisposition can affect how the body responds to insulin and glucose, making it more difficult for some women to manage their blood sugar levels even if they engage in regular physical activity.

Dietary habits also have a substantial impact on diabetes risk. A poor diet—characterized by high consumption of processed foods, sugary beverages, and unhealthy fats—can lead to weight gain and insulin resistance, both of which are major contributors to Type 2 diabetes. In China, urbanization has contributed to a shift away from traditional, nutrient-rich diets toward more Westernized diets that are high in calories and low in essential nutrients. This dietary transition, combined with a sedentary lifestyle, exacerbates the risk of developing diabetes.

Obesity is another critical factor that interacts with physical activity levels to increase the risk of diabetes. Excess body fat, particularly abdominal fat, is closely linked to insulin resistance. Obesity makes it more difficult for the body to use insulin effectively, leading to higher blood glucose levels. Women who are obese and physically inactive face a much higher risk of developing Type 2 diabetes. This is especially true for middle-aged women, who may experience weight gain due to hormonal changes during menopause, further increasing their diabetes risk.

The interaction between these factors creates a feedback loop: genetic predisposition may make it harder for an individual to manage weight or maintain healthy blood sugar levels, while poor diet and lack of exercise contribute to obesity, which in turn worsens insulin resistance. Together, these risk factors significantly increase the likelihood of developing Type 2 diabetes.

4.2 Importance of a Holistic Approach to Diabetes Prevention

Addressing Type 2 diabetes risk in middle-aged women requires a holistic approach that goes beyond simply encouraging physical activity. While exercise is a key component of diabetes prevention, it is essential to consider the broader range of factors that contribute to the disease.

A balanced diet that is low in processed sugars, unhealthy fats, and refined carbohydrates, and rich in fiber, vegetables, and lean proteins, is essential for reducing diabetes risk. Public

health campaigns aimed at improving dietary habits are crucial in China, where the transition to more processed foods and sugary drinks has contributed to the rise in obesity and diabetes.

Additionally, weight management programs are necessary to help women maintain a healthy body weight, which is a critical factor in preventing insulin resistance and Type 2 diabetes. Interventions should focus not only on encouraging physical activity but also on promoting portion control, healthy eating, and lifestyle changes that make long-term weight management sustainable.

Genetic counseling and awareness programs can also play an important role, particularly for women with a family history of diabetes. Understanding their genetic risk factors can empower women to make proactive lifestyle changes early on, such as engaging in regular exercise, monitoring their diet, and getting regular health screenings.

Finally, healthcare systems must take an integrated approach to diabetes prevention, combining physical activity promotion with dietary education, mental health support (since stress can exacerbate risk factors), and regular screenings for early signs of insulin resistance and blood sugar abnormalities.

By addressing all these factors—genetics, diet, obesity, and physical activity—together, a more comprehensive and effective strategy for preventing Type 2 diabetes can be developed. This holistic approach is particularly important for middle-aged women in China, who are often managing both professional and familial responsibilities and may struggle to prioritize their health amidst these competing demands.

5. Public Health Strategies to Increase Physical Activity

In recent years, China has implemented various public health initiatives to encourage physical activity, recognizing the critical role it plays in preventing chronic diseases such as Type 2 diabetes. One of the most significant government-led campaigns is the “Healthy China 2030” plan, which promotes regular exercise and healthier lifestyles across the population. This national strategy emphasizes reducing the burden of lifestyle-related diseases by advocating for increased physical activity and providing public education on its importance. Middle-aged women are a key demographic targeted by this campaign, given

their increased vulnerability to conditions such as diabetes and cardiovascular diseases due to sedentary lifestyles.

Public health messaging is widely disseminated through various media outlets, including television, radio, and social media platforms, which highlight the dangers of physical inactivity and the benefits of incorporating regular exercise into daily routines. These efforts have also been complemented by local government initiatives to improve access to exercise facilities. Many urban areas have expanded their public parks, created outdoor fitness centers, and improved recreational infrastructure, making it easier for residents to engage in physical activity. These spaces have become particularly popular among middle-aged women, who often participate in community fitness programs such as tai chi, group dancing, and walking clubs. Such initiatives are vital in promoting social engagement alongside physical activity, fostering a sense of community and mutual support.

While these large-scale efforts have succeeded in raising awareness about the importance of physical activity, more can be done to ensure these initiatives reach underserved populations, particularly in rural areas where resources are often limited. Moving forward, urban design will play a crucial role in enhancing physical activity opportunities. By creating pedestrian-friendly environments and integrating fitness facilities within neighborhoods, urban planners can make physical activity a natural part of daily life. For instance, building accessible parks, walking paths, and cycling routes can encourage women to incorporate moderate exercise into their daily routines. Similarly, public transportation systems that require walking between transit points can also contribute to higher activity levels among city residents.

Community-based interventions also offer significant potential for improving physical activity levels in middle-aged women. Organizing group exercise sessions, walking clubs, or fitness classes can provide both social support and motivation for women who might otherwise struggle to stay active. These programs not only promote physical well-being but also create a supportive network where participants feel accountable to each other and more likely to adhere to their exercise routines.

Collaborating with workplaces to implement wellness programs that offer flexible hours for physical activity during the workday could also be an effective strategy, particularly for women with busy schedules who may not have time to exercise after work.

Additionally, leveraging technology can further support public health strategies to increase physical activity. Fitness apps that track exercise, monitor health metrics, and provide personalized workout recommendations have gained popularity in China, offering users a convenient way to stay motivated and set fitness goals. These digital platforms also serve as educational tools, providing information about the benefits of physical activity and offering practical tips on how to stay active, even in constrained environments. By combining the accessibility of digital tools with community-based programs and urban planning, public health strategies can more effectively promote sustained physical activity among middle-aged women.

In conclusion, while significant progress has been made in promoting physical activity through public health initiatives, a more comprehensive approach is needed to fully address the physical activity deficit among middle-aged women in China. By improving urban design, fostering community-driven programs, and incorporating technology, public health strategies can significantly enhance physical activity levels, ultimately reducing the incidence of Type 2 diabetes and improving overall health outcomes for this demographic.

6. Long-Term Health and Economic Impact of Increased Physical Activity

Increasing physical activity levels among middle-aged women in China can have significant long-term health and economic benefits, both for individuals and the broader healthcare system. Regular physical activity plays a crucial role in preventing and managing chronic diseases such as Type 2 diabetes, cardiovascular conditions, and obesity, all of which are becoming more prevalent as China's population ages and urbanizes. The long-term impact of promoting physical activity extends beyond immediate health improvements and can lead to considerable savings in healthcare costs and enhanced quality of life for individuals.

One of the primary long-term benefits of

increased physical activity is the reduction in chronic disease incidence. For middle-aged women, regular physical activity helps regulate blood glucose levels, improves insulin sensitivity, and reduces the risk of developing Type 2 diabetes. Additionally, exercise improves cardiovascular health by lowering blood pressure, reducing cholesterol levels, and promoting heart function. These preventive effects mean that individuals who engage in regular physical activity are less likely to suffer from costly, long-term health complications. As chronic diseases often require lifelong treatment, preventing or delaying their onset through physical activity can significantly reduce the economic burden on both individuals and the healthcare system.

From an economic perspective, reducing healthcare costs is one of the most significant long-term impacts of increased physical activity. Treating chronic diseases such as diabetes can be extremely costly, both in terms of medical expenses and lost productivity due to illness or disability. By promoting physical activity, public health systems can prevent the onset of these diseases, thereby reducing the need for expensive treatments, medications, and hospitalizations. Studies have shown that individuals who maintain regular physical activity levels tend to have lower overall healthcare costs, as they experience fewer medical interventions and enjoy better health outcomes over time.

In addition to the financial benefits, regular physical activity can lead to an improved quality of life for individuals. Middle-aged women who engage in consistent physical activity report better physical and mental health, improved energy levels, and enhanced mobility. These benefits are particularly important as individuals age, as maintaining an active lifestyle can help reduce the risk of falls, fractures, and mobility-related health issues, enabling people to remain independent for longer. Mental health benefits also arise from regular exercise, including reduced symptoms of anxiety and depression, both of which are common among middle-aged and older women. A healthier, more active population not only contributes to reduced healthcare costs but also improves overall societal well-being.

Looking forward, future research is needed to further explore the long-term benefits of physical activity, particularly through

longitudinal studies. These studies would track middle-aged women in China over several years, assessing how their physical activity levels correlate with the development or prevention of Type 2 diabetes and other chronic diseases. Understanding the precise long-term effects of different types and intensities of exercise can help tailor public health recommendations to optimize outcomes for this demographic.

Moreover, research should focus on barriers to maintaining physical activity in the long term. Factors such as socioeconomic status, access to recreational facilities, and cultural attitudes toward exercise can all impact the sustainability of physical activity habits. Identifying and addressing these barriers through policy interventions or targeted public health campaigns would be essential in ensuring that the benefits of increased physical activity are not just short-term improvements but sustained changes that significantly reduce healthcare burdens and enhance quality of life over time.

In conclusion, the long-term health and economic impacts of increased physical activity in middle-aged women are profound. By preventing chronic diseases, reducing healthcare costs, and improving quality of life, promoting physical activity should be a central focus of public health strategies. Future research, particularly longitudinal studies, will be critical in further understanding the full extent of these benefits and in shaping policies that support long-term physical activity adherence in Chinese populations.

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