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■ Review Article

# Diabetes Prevention and Measures to Ensuring a Healthy Lifestyle during COVID-19 Pandemic and after

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The incidence of diabetes mellitus (DM) is increasing exponentially globally, with 90% of the confirmed cases being type 2 DM. The global incidence of DM is expected to increase by 48% during 2017–2045. The coronavirus disease 2019 (COVID-19) pandemic continues to have a massive impact on human health, causing sudden lifestyle changes through quarantine measures, such as lockdown, social distancing, various curfews, and isolation at home. This in turn might increase the risk of developing numerous chronic diseases, such as DM, obesity, and cardiovascular diseases, which increase the severity of COVID-19. To this end, we performed a comprehensive review to determine viable measures for the prevention of DM and its subsequent upsurge globally. Additionally, we have determined strategies that should be adopted globally to ensure a healthy lifestyle during the COVID-19 pandemic and later.

**Keywords:** Diabetes Mellitus; COVID-19; Prevention & Control; Healthy Lifestyle; Measures; SARS-CoV-2

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## INTRODUCTION

Diabetes mellitus (DM) is a chronic condition that occurs when the pancreas cannot produce sufficient insulin or when the body fails to efficiently use the insulin produced.[1] As of 2019, DM has affected approximately 463 million people globally, with 90% of confirmed cases of type 2 DM (T2DM).[2]

The coronavirus disease-2019 (COVID-19) pandemic, which is caused by the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), has revealed the severe and deleterious impacts of long-term inflammatory diseases, such as DM, on our immune systems.[3] The COVID-19 pandemic continues to have a massive impact on human health, causing sudden lifestyle changes globally, which in turn might increase the risk of developing numerous chronic diseases, such as DM, obesity, and cardiovascular diseases.[4]

The main focus of this review is to (1) identify viable measures for the prevention of DM and its subsequent upsurge globally and (2) determine strategies to ensure a healthy lifestyle during the COVID-19 pandemic and later.

## REVIEW METHODS

The PubMed, Google Scholar, Medline, Scopus, and other relevant national and global health databases (the World Health Organization [WHO], Center for Disease Control and Prevention, International Diabetes Federation, and American Diabetes Association) were searched comprehensively between May 2020 and December 2021 to obtain scientific data and viable literature. Articles within the last 2 years that discussed various methods for DM prevention and general strategies to maintain a healthy lifestyle during the COVID-19 pandemic were identified.

Specific search terms were used according to each section of this review. First, "prevention of diabetes/diabetes mellitus" were used to retrieve evidence-based literature on guidelines for the prevention of DM. Subsequently, the terms "healthy lifestyle measures" & "COVID-19" were used to obtain available literature on general strategies to ensure a healthy lifestyle during the COVID-19 pandemic. The results obtained from the searches were searched again to obtain available scientific literature and documents that have been subsequently used for discussions in the sub-headings.

No language or location barrier was set during the literature search, and all types of studies and literature were eligible for inclusion because of the nature of the review. Every abstract and web document was thoroughly screened by the investigator and an independent fellow to ensure the selection of the most viable data for the review. After implementation of the inclusion and exclusion criteria, 119 articles were obtained, grouped, and discussed under the following subthemes and headings in a narrative way.

## EVIDENCE-BASED RECOMMENDATIONS FOR PREVENTION OF DIABETES MELLITUS

Over the years, studies have established that DM is primarily caused by modifiable lifestyle factors.[1,2] The global incidence of DM is expected to increase by 48% between 2017–2045.[1] Moreover, DM has increased the risk of severe COVID-19-related complications.[3] Table 1 summaries some of the viable methods that the public could adopt for the prevention of DM.[5-51]

## GENERAL STRATEGIES FOR MAINTAINING A HEALTHY LIFESTYLE DURING THE COVID-19 PANDEMIC

The unprecedented COVID-19 pandemic has affected the daily activities of individuals globally. The emergence of new SARS-CoV-2 variants, such as the omicron variant, has resulted in the reintroduction of some preventive measures such as isolation, social distancing, travel cancellation, and restrictions by various individual health authorities globally, keeping people home-bound.

Isolation and prolonged stays at home may encourage the consumption of unhealthy diets, abuse of alcohol and other psychoactive substances, and normalization of a sedentary lifestyle, which is deleterious to health. This in turn may increase the risk of developing numerous chronic diseases, such as DM, obesity, and cardiovascular diseases, which can increase the severity of COVID-19. Thus, evidence-based methods must be adopted globally to ensure a healthy lifestyle during the COVID-19 pandemic and later.

### 1. Remain Active

Regular physical exercise improves the release of pro- and anti-inflammatory cytokines, lymphocyte circulation, and cell recruitment, which beneficially affects the immune system by reducing the occurrence, severity of symptoms, and death rates in viral diseases such as COVID-19.[52,53] Strategies to ensure physical activity could include home-based (indoor or confined exercises) and outdoor-based (outdoor exercises) activities. In the case of COVID-19-induced lockdowns and restrictions, indoor exercises will help prevent inactivity, idleness, and frequent bed rest. Additionally, it will promote adherence to exercise routines, which will improve health and prevent the development of other chronic diseases and severe COVID-19-related manifestations.[54]

Minimal-intensity aerobic activity at 60%–75% of maximum heart rate, 50%–60% of $VO_2$ maximum ($VO_2$max), and 40%–60% heart rate reserve, with a perceived exertion rating of 10–14 out of 20, for 3–5 days per week, and lasting 20–60 minutes per session, can be beneficial to people with chronic conditions such as DM and hypertension. Additionally, it promotes mental health and significantly improves the immune system, which helps prevent the occurrence of COVID-19.[55] Brisk and treadmill walking are examples of aerobic activities that confer these beneficial effects.[55] Furthermore, minimal-intensity aerobic activities (walking or cycling) for 20–60 minutes, 2–3 times per week,

**Table 1.** Evidence-based methods for the prevention of DM

| No. | Preventive methods | Key points |
|---|---|---|
| 1 | Regular physical activity | The adherence to routine physical activities can prevent of all types of DM and cardiovascular diseases and improves the overall health of people of all ages and gender. For significant health improvement, a minimum of 150 minutes of weekly low- or high-impact physical activity is required.[5-9] |
| 2 | Consumption of dietary fiber | The consumption of substantial quantities of dietary fiber (>25 g/d for women and >38 g/d for men) reduces the occurrence of T2DM[10] and prevents other chronic diseases.[11,12] This can be achieved by the consumption of natural plant foods and simultaneous reduction of intake of sugary and fat-laden foods.[13] |
| 3 | Frequent intake of total plant foods | The routine consumption of plant-based foods, such as vegetables, nuts, legumes, seeds, whole grains, and fruits, while simultaneously avoiding all animal food products is highly effective in preventing T2DM. The risks of macrovascular- and microvascular-related outcomes are reduced and T2DM is effectively managed.[14-17] |
| 4 | Cessation of smoking | Active and passive cigarette smoking significantly increases the occurrence of DM and its complications.[18] Hence, reduction or cessation of active or passive cigarette smoking will reduce the incidence of DM and other cardiovascular diseases.[19-21] |
| 5 | Maintaining a healthy body weight | Weight loss through dietary modifications and physical activity can prevent DM and cardiovascular outcomes in high-risk individuals; balancing of blood glucose levels prevents the emergence of these diseases.[22-24] The use of Livongo, a multifunctional mobile device which tracks blood pressure, blood glucose levels, and weight information and provides individualized lifestyle modifications, can help control blood glucose levels and maintain a healthy weight.[25] |
| 6 | Avoidance of alcohol | Excessive alcohol intake is a significant risk factor for the occurrence of DM, especially T2DM.[26-28] Alcohol intake exerts harmful effects on the present and future wellbeing of young patients with T1DM due to the major challenges in balancing the blood glucose levels.[29] |
| 7 | Avoidance of fat- and sugar-rich diets | Extra adiposity which occurs from sugary and fatty foods increases the occurrence of non-insulin-dependent T2DM.[30] The consumption of certain fats such as fish and marine n-3 fatty acids can prevent T2DM.[30-33] |
| 8 | Avoiding drugs that induce diabetes | Beta-blockers, statins, corticosteroids, antipsychotics, and thiazide diuretics are associated with an increased incidence of T2DM due to their role in increasing body weight and blood glucose levels.[34] However, the risks are usually reversed after discontinuation or reduction in the dosage of the drugs.[34] Metformin offers a 29% preventive effect against the advancement of pre-DM to T2DM in high-risk populations.[35] In combination with lifestyle modifications, and with caution for gastrointestinal complications, acarbose can delay the progression to T2DM in people with impaired glucose tolerance.[36] |
| 9 | Preventing cardiovascular diseases | Cardiovascular disease-related mortality is high in patients with T2DM, and the rate of hypertension is substantially higher in patients with T2DM than in the general population.[37,38] A blood pressure reading of 140/85 mm Hg should be the minimal therapeutic goal for patients with T2DM to reverse and reduce this effect.[39] Normal blood pressure can be achieved through a healthy diet, maintenance of a healthy weight, and frequent physical activities.[37] Medications for the normalization of blood pressure should be personalized to the individual's age, gender, ethnicity, and existing health conditions.[37] |
| 10 | Infection prevention | Infections negatively affect insulin resistance through the proinflammatory cytokine and acute-phase responses and alteration of the nutrient levels.[40] Specifically, there is a significant association between *Helicobacter pylori* infection and the occurrence of T2DM due to pancreas β-cell impairment, lipotoxicity, and glucotoxicity.[48] Thus, *H. pylori* infection prevention and eradication are needed to mitigate the occurrence of T2DM in high-risk individuals.[41,42] |
| 11 | Regular medical checkups and screenings | Regular medical screening for T2DM is pertinent for the early diagnosis of the disease.[43] The ADA recommends regular blood glucose screening for high-risk individuals: (1) >45 years of age, (2) overweight or obese at any age, (3) prediabetes, (4) inactive and sedentary lifestyles, and (5) family history of DM.[44] Oral glucose tolerance test, fasting and 2-hours postprandial glucose values, 1-hour glucose value, waist circumference, and the reverse iontophoresis-based EZSCAN technology are some of the standardized, globally accepted screening methods for diabetes.[45] |
| 12 | Prevention of depression and stress | Depression is associated with a 41% occurrence of DM and 32% occurrence of T2DM.[46] Non-severe, persistent, and untreated depression usually increases the risk of DM.[47,48] Stress is an established causative factor for T2DM and plays a significant role in the progression of new onset T2DM and T1DM.[49-51] Depression and stress must be appropriately prevented and treated because of the deleterious health consequences that occur with the combination of DM and depression or stress.[48] |

DM, Diabetes mellitus; T2DM, type 2 diabetes mellitus; T1DM, type 1 diabetes mellitus; ADA, American Diabetes Association.

with an intensity of 55%–80% $VO_2$max or 60%–80% of maximum heart rate, will enhance immune parameters (leukocytes, lymphocytes, neutrophils, monocytes, eosinophils, interleukin [IL]-6, CD16-56, CD16, CD4, CD3, CD8, and CD19) of people with COVID-19 without any adverse effects.[56]

The WHO's advisory of physical exercise requirements (at least 150 minutes of minimal-intensity physical exercise, 75 minutes of high-intensity physical exercise, or an equivalent combination of the 2 weekly) could still be met when staying at home; a combination of five home duties in a week for >5 minutes each daily can be performed.[57] Furthermore, following phone app exercise sessions (Aaptiv, Strava, Peloton, Nike training club, and Zombies Run), television exercise programs, or exercise instructions on the radio will enable adherence to routine physical activities while at home.[58]

## 2. Diet and Nutrition

Adequate diet and nutrition ensure an optimal immune system to prevent infectious illnesses.[59] Suboptimal nutrient levels are related to inflammation and oxidative stress, which affects the body's immunity.[59] Adequate protein consumption is important for higher antibody secretion, while reduced vitamin A or zinc levels increase the odds of infection.[59] Most of the patients hospitalized with COVID-19 experienced malnutrition and lower levels of vitamins C, D, and B12, selenium, iron, omega-3, and medium- and long-chain fatty acids, indicating the importance of nutritional intervention for the prevention of COVID-19.[60] Vitamins C, D, and E and phytochemicals (carotenoids


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and polyphenols) exert higher anti-inflammatory and antioxidant functions in the body, which prevents viral infections.[61] In addition, dietary fiber fermented into short-chain fatty acids exerts beneficial anti-inflammatory functions.[61]

The six vitamins recommended by the European Food Safety Authority are (D, A, C, Folate, B6, and B12) and four minerals (zinc, iron, copper, and selenium) are beneficial for optimal immune functioning.[62] Furthermore, optimal consumption of vitamins D, C, and B and iron-rich diets is associated with lower COVID-19 occurrence and death.[62] The supplementation of these essential micronutrients in vulnerable populations and COVID-19-affected individuals in underdeveloped and developing countries is warranted to diminish the risks of death and severe outcomes during this pandemic.[63]

Frequent adherence to the Mediterranean diet confers substantial protection against the development of COVID-19.[64] The high consumption of sugar-flavored foods, saturated fats, and manufactured carbohydrates (Western diet) increases the occurrence of DM, obesity, and hypertension, risk of COVID-19 infection, and adaptive immunity-related severe outcomes.[64] An unhealthy diet and COVID-19-related peripheral inflammation may lead to long-term deleterious health conditions, such as neurodegenerative diseases and dementia, via multiple neuroinflammatory mechanisms in people who have recovered from COVID-19.[65] Thus, the consumption and access to a healthy diet is imperative and should be a global priority during and after this pandemic.[65]

The WHO recommends at least 4 and 5 serving units of natural fruits and fresh vegetables, respectively, in a day to strengthen the immune system and reduce the occurrence of chronic conditions during this pandemic.[66] Furthermore, a combination of unrefined cereal grains (180 g), assortments of beef (excluding red meat), and beans (160 g) was also suggested by the WHO for optimal nutrition during this pandemic.[66] Natural fruit, dietary fiber, and fresh vegetable sources are rich in important nutrients, such as vitamins (A, C, D, B6 and B12) and other essential micronutrients, which are important for optimal immune function and protection against COVID-19 during this pandemic and later.[67]

### 3. Adequate Sleep

Adequate and high-quality sleep are imperative in promoting mental and physical well-being. Inadequate sleep leads to low performance, limited alertness, and a general diminishment of health quality.[68] Inadequate sleep is a predisposing factor for malignancies, substance abuse, depression, suicidal thoughts, serious inflammation, stroke, immune system deficiencies, and numerous infections and illnesses that result in severe outcomes, such as COVID-19.[69]

The ongoing COVID-19 health crisis has negatively affected the sleep of the majority of people globally, with many reporting manifestations of insomnia.[70] The general public and medical personnel have been primarily affected by sleep problems.[70] Inadequate or intermittent sleep, which is common among medical personnel on shifts, first responders or paramedics, and social workers, has affected the well-being, immune function (innate and acquired immunity), pro-inflammation stimulation, and susceptibility to viral infections, such as SARS-CoV-2, of an individual due to inflammation and hormonal imbalance.[71] Interruption of breathing during sleep (sleep apnea) is an identified risk factor and a major predisposing factor for COVID-19.[71,72] Moreover, inadequate sleep increases the incidence of common cold in a dose-dependent manner.[73] These findings suggest that a sleep duration of 7 to 9 hours a night (for adults) could improve the effectiveness of an individual's immune system, resulting in rapid responses against other viral upper respiratory infections, such as COVID-19.[73]

Adequate sleep may modulate fast adaptive immune responses to infection. Spiegel et al.[74] examined the effect of inadequate sleep on the human antibody response to influenza immunization in 25 people; patients who slept for 8 h/night developed double the immunoglobulins and antibodies against the influenza virus within 10 days after immunization than those who slept for 4 h/night did. Prather et al.[75] examined the association between sleep and antibody responses to hepatitis B immunization; inadequate sleep in normal settings negatively affects an individual's immune response to new antigens, which possibly explains the association between inadequate sleep and increased susceptibility to infectious diseases. Currently, there is no direct study on the effect of sleep on COVID-19 vaccine and immunity. Nonetheless, the findings of these studies indicate that adequate sleep (7–8 h/night) could improve the immunity of people who have been vaccinated against COVID-19.[76]

### 4. Personal Care and Hygiene

During this pandemic, body and skin hygiene has been crucial. Bathing regularly, preferably twice a day (morning and night), with antiseptic soap and clean running water and regular washing of clothes with germ-killing detergents may kill SARS-CoV-2.[77]

Regular dental hygiene during this pandemic and later is imperative; people with periodontal disease may be at an increased risk of severe outcomes from COVID-19 than the general population are.[78] A potential relationship between periodontal disease and COVID-19 has been established through two routes. First, the angiotensin-converting enzyme-2 (ACE-2) and CD147 receptors, which is used by SARS-CoV-2 to infect new cells, increases appreciably in the presence of periodontal disease, thus possibly promoting a viral infection.[78,79] Second, IL-6 and IL-17 could potentially cause the onset of periodontal diseases and serious COVID-19 infections.[78,79]

### 5. Avoidance of Psychoactive Substances

Chronic alcohol intake is associated with the onset of numerous diseases and may be a risk factor for COVID-19.[80] It may also worsen psychological and organic conditions, thereby predisposing an individual to behavioral actions that increase the risk of developing and severity of COVID-19.[80] A minimal quantity of alcohol can affect the immune response by increasing the inflammatory responses in the body.[81] This plays an important role in the development of pancreatitis and alco-

holic liver disease and negatively affects several other tissues and organs in the body.[81] Furthermore, anti-inflammatory cytokines are affected by alcohol intake.[81] Acute alcohol consumption interrupts the healthy functioning of the entire immune system (adaptive immunity), which includes cell-mediated and humoral actions, thereby increasing the risk of any bacterial and viral infections, such as SARS-CoV-2, in chronic alcohol abusers.[81]

Smoking impairs lung immune activity and increases the risk of infections from other communicable diseases and the subsequent severe health consequences in patients infected with COVID-19.[82] Smoking is a major contributing factor to the development of COVID-19.[82] Kashyap et al.[83] determined that chronic smoking is related to higher disease severity and number of deaths in patients hospitalized for COVID-19. Smoking can also impair the ACE-2 receptors used by SARS-CoV-2 to gain entry into the host cell and initiate cytokine problems, which often leads to severe consequences in patients with COVID-19.[83] All types of smoking produce exhaled smoke, sneezing or coughing, fumes, and aerosols, which may contain SARS-CoV-2, which in turn could contaminate surfaces and surroundings.[84] Thus, smoking tobacco, especially in poorly ventilated places, could transmit SARS-CoV-2 in serious, passive and non smokers.[84]

Cannabis use is related to several serious health consequences, such as respiratory/breathing complications (serious cough and air accumulation in the lung tissues), immune system disruption, and a high risk of contracting or spreading viral infections (SARS-CoV-2 and others).[85] Thus, smoking or cannabis use during the COVID-19 pandemic should be avoided to prevent infection and COVID-19-related complications.

### 6. General Healthcare Maintenance

People with COVID-19, obesity, DM, heart diseases, severe obstructive lung disease, cancers, human immunodeficiency virus, hypertension, and other underlying medical conditions are prone to developing severe outcomes (morbidity and mortality) due to the strong affinity of the SARS-CoV-2 to ACE-2 receptor, which is expressed more in patients with comorbidities.[86]

Nikoloski et al.[87] determined that people with specific medical conditions, including hypertension, heart diseases, severe liver and kidney diseases, DM, and serious lung conditions, are negatively affected by COVID-19 than people without any medical conditions; SARS-CoV-2 has a strong affinity for the ACE-2 receptor and a hyper-inflammatory response (cytokine storm) is commonly seen in people with comorbidities. Furthermore, Bajgain et al.[88] identified that hypertension, DM, and heart diseases were the most frequently reported comorbidities in patients with COVID-19 across global hotspot areas.

Medications commonly used in the management of hypertension or DM, such as insulin, do not aggravate the overall health condition in COVID-19 patients with co-morbidities.[87] Thus, people with underlying medical conditions, must adopt appropriate COVID-19 preventive measures, continue to take the medications prescribed for their comorbidities under supervision as instructed, and restock them as necessary to avoid shortages.[86,89] Due to the high susceptibility and severity of COVID-19 among people with comorbidities, such patients should be prioritized globally for receiving the vaccination.[87]

The provisions for essential medications (such as insulin), routine screening, and monitoring services, were disrupted during the pandemic.[90] Presently, the goal is to control the transmission and effects of COVID-19 globally. Nonetheless, healthcare providers should meet the basic health needs of all categories of people worldwide. For patients with DM, basic health services include the routine messaging of patients and susceptible groups regarding the probable risk of COVID-19 infection measures for the prevention and management of their condition; provision for continuous support and assistance through telephone calls, video calls, and house visits while adhering to COVID-19 preventive measures; and ensuring rapid and uninterrupted accessibility to all essential medications.[90] Additionally, routine screening and monitoring should continue during the pandemic for cancers and other medical conditions to prevent late and missed diagnoses of diseases.[91]

Vaccination programs for other preventable diseases should be continued globally. Primary health providers should critically evaluate the immunization status of all categories of people, with particular attention to children and patients with comorbidities.[92] Those falling behind in their immunization schedules should be contacted so as to prevent severe public health crises that might ensue from vaccine-preventable disease epidemics, especially since schools are gradually reopening for in-person learning.[92] Yang et al.[93] and Conlon et al.[94] determined that complete vaccination against other preventable diseases, such as influenza, might confer some level of protection against COVID-19, thereby reducing severe outcomes, infection rates and the burden on the healthcare system.

### 7. Promoting Positive Mental Health

There has been an exponential rise in stress, anxiety, depression, sleep problems, fear, and mental distress globally during the COVID-19 pandemic, particularly in female medical personnel, patients with COVID-19, and family members of patients suffering from COVID-19.[95,96] Guerrini et al.[97] identified some of the major contributors to abnormal psychological manifestations in the population, including lower earnings, younger age, Latino or Hispanic ethnicity, employment or work exposure to COVID-19, living with first-responders and healthcare personnel, COVID-19 status, reduced participation in healthy behaviors (such as physical exercises), and increased participation in unhealthy behaviours.

Over the years, the associations between depression, stress, and human health have been established through alterations in the normal functioning of the immune system and the production of various inflammatory properties that promote numerous infections and metabolic diseases in individual.[98] Short-term stress may initiate a possible sympathoadrenergic-mediated increase in chemotaxis and adhesion molecule expression, which distributes immune cells to locations of infection and/or inflammation. However, long-term stress disrupts


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this process, rendering this mechanism unbeneficial.[99] Furthermore, long-term stress alters and disrupts the ability of the immune system to secrete or produce antibodies in response to a vaccine, thus making a chronically stressed individual susceptible to infections.[99]

Depression and anxiety exert severe effects, including death, in patients with COVID-19 during the pandemic. Wang et al.[100] determined that participants with diagnosed mental health problems had a significantly higher risk of developing COVID-19 with severe outcomes than those without mental health problems, as evidenced by the higher rates of COVID-19-related mortality, particularly in those with dementia. Furthermore, late-life anxiety heightened the risk of developing COVID-19, while late-life depression was associated with a higher risk of infection and severe outcomes.[100] Thus, interventions to improve and promote the mental health of highly susceptible people during the pandemic should be adopted globally.[100,101]

Meditation and mindfulness can be employed by medical personnel, patients, caregivers, and the global population to improve mental health conditions during the pandemic.[102] Mindfulness-centered stress reduction methods effectively improve depression, anxiety, pain status, and stress in populations of all ages,[102] at a reduced financial cost while complementing the treatment of COVID-19.[102,103]

Physical exercise reportedly prevents anxiety and depression, regardless of the age and gender of the individual.[104] Specifically, higher levels of physical exercise prevent post-traumatic conditions and agoraphobia.[104] During the COVID-19-induced confinement, the long periods of inactivity predisposes the public to numerous health risks and mental health problems, such as anxiety, stress, and depression; participating in physical exercise is effective and should be used by healthcare workers and the general public to improve their mental health.[105,106] Furthermore, yoga techniques improve sleep quality, prevent anxiety and stress, and strengthen the immune system responses to infections.[107] In the case of lockdowns, restrictions, and work demands, the internet is a good alternative for the dissemination of yoga techniques.[107]

A balanced diet, prebiotics, and probiotics offer some benefits for the improvement and promotion of positive mental health.[108] The routine consumption of diets that are abundant in edible fibers and omega-3-polyunsaturated fatty acids (≥5 g/d) may confer protection against stress, depression, and anxiety.[108,109]

### 8. Social Connections

Social support is important for health and can be seriously affected by measures, such as physical distancing and confinement, for the prevention of SARS-CoV-2 transmission.[110] During the COVID-19 crisis, social support was important to ensure connectedness.[110] Constant communication with distant family members and friends during the pandemic prevents stress and anxiety, dissatisfaction with life, and instances of loneliness and sadness.[111] Computer-mediated communication, which involves human communication via the use of two or more electronic devices, provides individuals with opportunities to remain in contact with loved ones and family members, while not compromising COVID-19 prevention measures.[112] Thus, the provisions for fast and high-quality internet, quality communication gadgets, and improved media literacy of the general population are warranted globally.[112]

### 9. Continuation of the COVID-19 Preventive Measures

The most viable and effective nontherapeutic method to halt and abate the spread of SARS-CoV-2 is the adherence to all basic COVID-19 preventive measures.[113] As the pandemic lingers on and more contagious variants of the SARS-CoV-2 emerge, such as the omicron and delta variants, the general public must continue to follow all COVID-19 preventive measures: physical distancing of at least 1 m, self-quarantine, isolating when infected with COVID-19 or after contact with an infected person and immediately contacting the health service provider, regular and appropriate use of face covers, routine hand washing with soap and clean running water for a duration of at least 20 seconds, respiratory hygiene, frequent surface cleaning, and avoidance of crowded places.[114] If strictly followed and adequately implemented, these measures may also help prevent the spread of influenza and numerous other upper respiratory infections.[115] Even after an individual has been fully vaccinated for COVID-19 or has recovered from COVID-19, all preventive measures should be followed to prevent reinfection and subsequent spread.[116]

### 10. Vaccination against COVID-19

Numerous COVID-19 vaccines have been proven safe and effective by numerous regulatory bodies globally.[117] Complete immunization against COVID-19 effectively protects and prevents against contraction and spread of the SARS-CoV-2.[118] Furthermore, it prevents the development of severe illness and outcomes if infected with COVID-19, which is particularly important in people with underlying medical conditions.[118] Children should be prioritized for COVID-19 vaccination. Presently, health authorities have approved the use of the Pfizer, Johnson & Johnson, and Moderna vaccines for children over the age of 5 years, and individuals over the age of 18 years in the United States.[119] Currently, there is no COVID-19 vaccine which has been approved for children under the age of 5 years. To receive the COVID-19 vaccine, individuals should contact their personal healthcare providers or seek information at the nearest vaccination centers. The public should regularly contact their healthcare providers in case of changes to vaccination requirements, such as the need for booster shots, especially in the face of the emergence of new contagious variants of SARS-CoV-2.

## CONCLUSION

With respect to the yearly global surge in the incidence of DM and the severe health outcomes resulting from the infection of COVID-19, this evidence-based extensive review provides comprehensive, efficient, and viable information on the methods for DM prevention that is generally acceptable globally. Additionally, we have included strategies that should be adopted globally to ensure a healthy lifestyle during the

COVID-19 pandemic and later.

## CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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