



Chapter 2.
Epidemiology of Diabetes and
Ramadan Fasting
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2.1 The global impact of diabetes

The prevalence of diabetes has been increasing throughout the world over recent decades and the trend is set to continue [1, 2]. Estimates for 2015 indicated that there were approximately 415 million people with diabetes in the world, which could rise to 642 million in 2040; a 55% increase [1]. In 2015, 5 million deaths were caused by diabetes, with all nations suffering the impact of this epidemic [1]. The worldwide financial burden of diabetes is also vast, consuming 11.6% of total global health spending in 2015 (USD 673 billion) [1].



There are at least 415 million people living with diabetes throughout the world

The countries with the highest number of adults with diabetes in 2015 were China, India and the United States of America, with three Muslim-majority countries (Egypt, Indonesia and Bangladesh) being in the top 10. (**Table 1**) [1, 3].

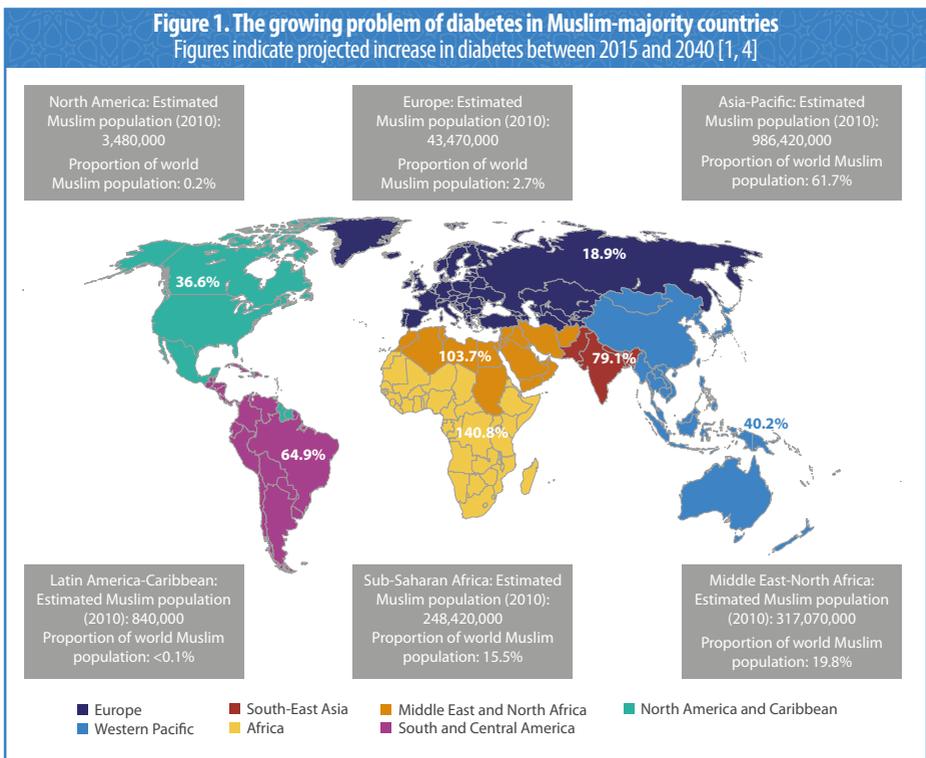
Table 1. Top 10 countries/territories for number of adults with diabetes [1, 3]

| Country/territory | Number of adults with diabetes (2015) | Muslim population (2010, %) |
|--------------------------|---------------------------------------|-----------------------------|
| China | 109.6 million | 1.8 |
| India | 69.2 million | 14.4 |
| United States of America | 29.3 million | 0.9 |
| Brazil | 14.3 million | <0.1 |
| Russian Federation | 12.1 million | 10.0 |
| Mexico | 11.5 million | <0.1 |
| Indonesia | 10.0 million | 87.2 |
| Egypt | 7.8 million | 94.9 |
| Japan | 7.2 million | 0.2 |
| Bangladesh | 7.1 million | 89.8 |

Prevalence rates in many countries in the Middle East and North Africa are well above the average global prevalence of 8.8%, and the region as a whole has the second-highest comparative prevalence of diabetes (10.7%) [1]. Diabetes accounted for approximately 342,000 adult deaths in the Middle East and North Africa in 2015, and more than half of these deaths were in those aged less than 60 years [1].

The Middle East and North Africa region also has a high and growing Muslim population [4]. Muslims comprise almost a quarter of the world's population, with nearly 1.6 billion followers of Islam worldwide as of 2010 [4]. The worldwide Muslim population is projected to increase by 73% by 2050, which will make Islam the fastest-growing world religion over the next four decades [4]. Most Muslim-majority countries are in less-developed regions of the world, and developing countries are disproportionately affected by diabetes [1, 2, 5]. Currently, 75% of people with diabetes live in low- and middle-income countries [1]. As a result of rapid modernisation, the demographic patterns in developing Islamic countries are changing substantially [1, 2]. Future generations will see increases in life expectancy and urbanisation, and a reduction in the infectious disease burden, all of which will contribute to an increase in diabetes prevalence in these regions (**Figure 1**) [2]. Moreover, dramatic development changes are already having a negative impact on lifestyle in these regions, such as increasing the levels of poor-quality nutrition and sedentary behaviour, facilitating weight gain that in turn increases the risk of diabetes [6, 7]. Smoking, another diabetes risk factor, is also a growing problem in low- and middle-income countries [8, 9].

Figure 1. The growing problem of diabetes in Muslim-majority countries
 Figures indicate projected increase in diabetes between 2015 and 2040 [1, 4]



Although the increase in diabetes in other regions, such as Europe and North America is predicted to be less pronounced, it is important to note that diabetes prevalence may vary between communities within the same country. For example, a study in the UK found the age-standardised prevalence of type 2 diabetes (T2DM) in South Asians to be almost four times higher than for non-South Asians [10]. In this study, two of the three countries of ancestral origin classified as South Asian were Muslim-majority countries (Pakistan and Bangladesh) [10]. Patients with diabetes who belong to ethnic minorities in the UK and in North America have been found to be at higher risk of developing diabetes-related complications [11].

2.2 Diabetes and Ramadan

Ramadan is a holy month for Muslims and, as one of the five pillars of Islam, fasting during this time is prescribed. The month lasts for 29–30 days, during which time the consumption of food and drink, as well as oral and injected medications, is forbidden between dawn and dusk. Depending on the season and geographic location, each period of fasting may last for up to 20 hours. Fasting is mandatory for all Muslim adults, with certain groups exempted, such as those who are suffering with illness – this may include some individuals with diabetes. Because of the metabolic nature of the disease, patients with diabetes are at particular risk of complications from marked changes in food and fluid intake. Potential health hazards include hypoglycaemia, hyperglycaemia, dehydration and acute metabolic complications such as diabetic ketoacidosis (DKA) [12]. Despite being exempt, many people with diabetes do participate in fasting during Ramadan. It is important that the decision about whether to fast is made on an individual basis in consultation with the patient's treating physician, taking into account the severity of illness and the level of risk involved [12]. These topics are considered in more detail in other chapters.

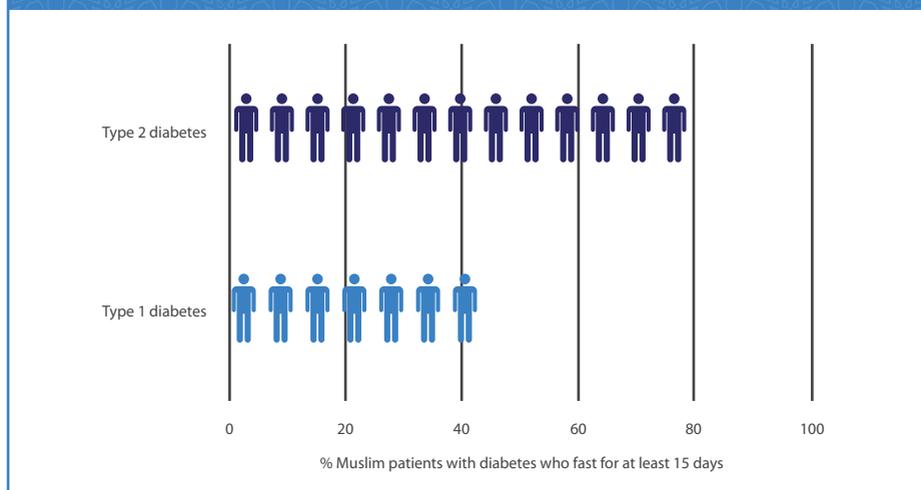
Fasting during Ramadan may provide enduring benefits. Indeed, Ramadan can provide an opportunity for a better lifestyle, facilitating weight loss and smoking cessation [13]. For patients with diabetes who choose to fast, Ramadan may help to strengthen the therapeutic alliance between patient and physician, and may provide an opportunity to improve diabetes management, with a focus on self-care and the regulation of medication and meal timing.

2.3 The epidemiology of diabetes and Ramadan fasting

In the landmark Epidemiology of Diabetes and Ramadan (EPIDIAR) study, information was collected from 12,243 Muslim people living with diabetes across 13 countries in 2001 [14]. The population was mainly urban (80%), with a mean age of 31 and 54 years for type 1 diabetes (T1DM) and T2DM, respectively [14]. Only 67% of patients with T1DM and 37% of patients with T2DM were self-monitoring

their blood glucose levels [14]. The study found that 42.8% of patients with T1DM and 78.7% of those with T2DM reported fasting for at least 15 days during Ramadan (**Figure 2**) [14]. Combining EPIDIAR data with the most recent estimates for the global Muslim population and global diabetes prevalence suggests that there are 148 million Muslims with diabetes across the world, of whom over 116 million may fast during Ramadan.

Figure 2. Up to 79% of Muslims with diabetes fast for at least 15 days during Ramadan [14]



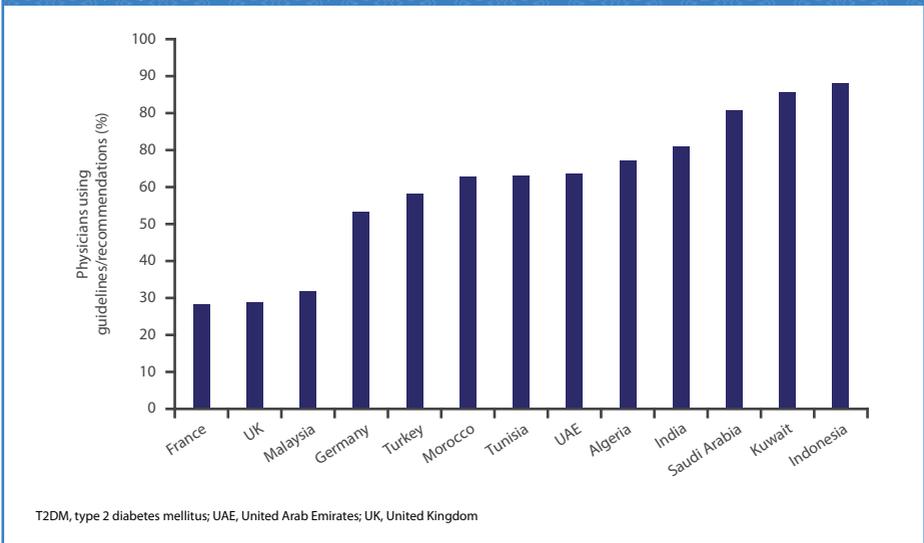
Approximately half of the overall EPIDIAR study population did not change their lifestyle during Ramadan, including physical activity levels, sleep duration and food, fluid and sugar intake [14]. Recommendations from treating physicians were provided to 68% of patients with T1DM and 62% of patients with T2DM, and the majority of patients did not change their medication dose [14]. The number of severe hypoglycaemic episodes per patient per month was significantly higher during Ramadan than during the preceding year for all patients [14]. A relationship was observed between the incidence of severe hypoglycaemia and a change in medication dose; 38.4% and 55.3% of patients reporting severe hypoglycaemia had changed their oral anti-diabetic drug (OAD) or insulin dose respectively, compared with 19.7% and 36.7% of those without severe hypoglycaemia [14]. The number of hyperglycaemic episodes was also significantly higher during Ramadan for patients with T2DM [14]. The EPIDIAR study highlighted the various challenges that arise during Ramadan fasting for patients with diabetes and their healthcare professionals (HCPs). It also revealed a number of opportunities to improve the management of diabetes during this holy month, such as increasing the dissemination of fasting guidelines and the provision of patient education (pre-Ramadan counselling).

Indeed, since the publication of the EPIDIAR study, several recommendations for the management of diabetes during Ramadan have been developed, along with educational programmes [12, 15-17].

i Estimates suggest that there are 148 million Muslims with diabetes worldwide

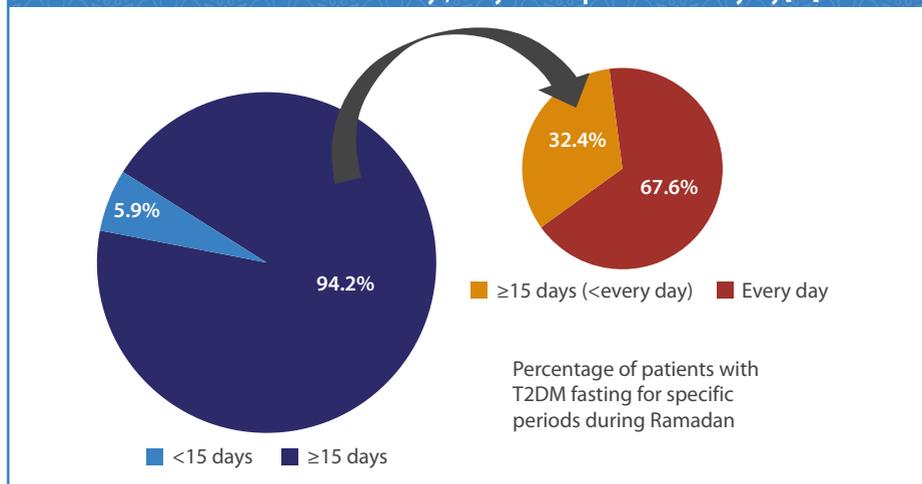
Just over a decade after the publication of the EPIDIAR study, the multi-country, retrospective, observational study of the management and outcomes of patients with T2DM during Ramadan in 2010 (CREED) was published [18]. A total of 508 physicians across 13 countries were selected to participate in the study. Participants were invited to enrol patients with T1DM, T2DM or gestational diabetes aged ≥ 18 years, who fasted for any period of time during Ramadan 2010 [18]. A total of 3,777 patients were enrolled, providing 3,394 evaluable cases, and data were reported for a subset of 3,250 patients with T2DM [18]. Among the physicians evaluated, 96.2% had provided advice to fasting patients [18]. Guidelines or recommendations for the management of diabetes during Ramadan were used by 62.6% of physicians, with notable inter-country differences (**Figure 3**) [18]. The recommendations developed in collaboration with the American Diabetes Association (ADA) were the most commonly used set of management guidelines or recommendations [18]. For each patient participating in the study, physicians were asked to assess the risk of adverse events using the ADA recommendations. Physicians reported that 33.3% of

Figure 3. There is variation between countries in the use of guidelines or recommendations by physicians for the management of T2DM in patients who fast during Ramadan [18]



patients were at low risk and 31.4% were at moderate risk, with wide variability between countries regarding the percentage of patients stratified to different levels of risk [18]. Of the patients evaluated, 94.2% reported fasting for at least 15 days during Ramadan and 63.6% of patients fasted every day during the month (**Figure 4**) [18]. These data therefore indicate that many patients who are considered to be at high or very high risk of adverse events still fast during Ramadan. This is despite the ADA recommendation that those at high risk should be advised against prolonged fasting [16].

Figure 4. According to the CREED study, 94.2% of Muslims with T2DM who fast during Ramadan fast for at least fifteen days; many of these patients fast every day [18]



The proportion of patients fasting for at least 15 days was fairly consistent across countries included in the study, being greater than 90% for 10 of the 13 countries evaluated [18]. The proportion of patients fasting every day was more varied, being highest in Algeria (83.5%), United Arab Emirates (78.8%) and Saudi Arabia (78%), and lowest in Morocco (22.9%), despite 95.6% of Moroccan patients in the study choosing to fast for at least 15 days [18]. The mean number of fasting days was 27, the same as in the EPIDIAR study [14, 18]. During Ramadan, most patients (64.1%) consumed just two meals per day [18]. There are other times during the year when Muslims may voluntarily fast and the CREED study reported that 29.9% of patients evaluated also fasted outside of Ramadan (ranging from 8% in India to 46% in Malaysia) [18]. Indeed, the ADA recommendations for management of diabetes during Ramadan were updated in 2010 to reflect the requirement for awareness of voluntary fasting throughout the year [15].



Nearly 30% of Muslims with diabetes who fast during Ramadan also fast at other times of the year

The majority of patients in the CREED study were receiving OAD regimens (76.6%) before Ramadan. A change in diabetes regimen in preparation for Ramadan was reported for a total of 39.3% of patients [18]. Frequency of administration (74.8%) was changed more frequently than was total daily dose (36.9%) or the drug itself (defined as a drug discontinuation, addition or switch; 20.4%) [18]. A change in frequency of administration was more common regardless of whether the patient was receiving oral or injectable therapy [18]. During Ramadan, at least one episode of hypoglycaemia was reported by 8.8% of patients with T2DM, compared with 5.4% before Ramadan; 47.8% of hypoglycaemic episodes necessitated cessation of the fast [18]. This hypoglycaemia rate is in line with that observed in a prospective observational study in Pakistan, in which patients received education regarding drug dosage and timing alteration, glucose monitoring and other lifestyle modifications [19]. However, other studies have reported much higher rates of hypoglycaemia during Ramadan (up to 41.7% for patients treated with sulphonylureas) [20, 21]. Such discrepancies may reflect differing levels of patient education and medication management across regions. Indeed, Ramadan-focused education has been shown to be beneficial in reducing the incidence of hypoglycaemia [22, 23].

In the CREED study, 96.2% of physicians reported giving advice to patients who fasted during Ramadan. In contrast, only 62% of patients with T2DM were provided with recommendations about fasting during this month in the EPIDIAR study [14, 18]. The EPIDIAR and CREED studies have notable differences including study design, the number of cases evaluated and the countries studied, making comparisons between the studies problematic. However, this marked increase in advice may reflect a change in physicians' practice as a result of guidelines becoming available, such as those developed in collaboration with the ADA.

The CREED study did not take into account those patients who did not visit their HCP in the lead up to Ramadan, and there are many patients with diabetes who do not receive specialised advice regarding fasting. Moreover, there are 193 million cases of undiagnosed diabetes across the world [1]. Indeed, estimates for 2015 predict that over 40% of cases of diabetes in the Middle East and North Africa were undiagnosed [1]. Health resources across the region need to be redirected to manage the soaring diabetes prevalence, ensuring the provision of adequate education and care for patients and for those at risk of developing diabetes [1]. As the number of Muslims with diabetes continues to increase, it will be paramount to ensure that both HCPs and patients throughout the world are fully aware of the recommendations and best practice approaches to diabetes care for those choosing to fast during Ramadan.

Summary

- The prevalence of diabetes is increasing throughout the world with estimates suggesting there will be 642 million people with diabetes by 2040; this increase is predicted to be particularly marked in Muslim-majority countries.
- Estimates suggest that there are 148 million Muslims with diabetes worldwide.
- Despite being exempt, the majority of Muslim patients with diabetes fast for at least half of the month of Ramadan. Many patients also fast at other times during the year.
- The provision of advice to patients with diabetes who fast during Ramadan appears to be increasing in line with the advent of guidelines for physicians, such as those developed in collaboration with the ADA.
- However, changes to diabetes regimens appear to be implemented in a low proportion of patients who fast during Ramadan.

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