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Digitising diabetes education for a safer Ramadan: Design, delivery, and evaluation of massive open online courses in Ramadan-focused diabetes education

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ARTICLE INFO

ABSTRACT

Aims: Ramadan-focused diabetes education is critical to facilitate safer Ramadan fasting amongst Muslim people living with diabetes. We present the design, delivery, and evaluation of two parallel massive open online courses (MOOCs) in Ramadan-focused diabetes education for people with diabetes and HCPs.

Methods: Two Ramadan-focused diabetes education MOOCs were developed and delivered for Ramadan 2023: one for HCPs in English, and another for people with diabetes in English, Arabic and Malay. A user-centred iterative design process was adopted, informed by user feedback from a 2022 pilot MOOC. Evaluation comprised a mixed-methods evaluation of pre- and post-course user surveys.

Results: The platform was utilised by people with diabetes and their family, friends and healthcare professionals. Overall, a total of 1531 users registered for the platform from 50 countries, 809 started a course with a 48% subsequent completion rate among course starters. Qualitative analysis showed users found the course a user-friendly and authoritative information source. In the HCP MOOC, users reported improved post-MOOC Ramadan awareness, associated diabetes knowledge and ability to assess and advise patients in relation to their diabetes during Ramadan (p<0.01).

Conclusions: We demonstrate the potential of MOOCs to deliver culturally tailored, high-quality, scalable, multilingual Ramadan-focused diabetes education to HCPs and people with diabetes.

1. Introduction

Ramadan fasting holds great cultural and religious significance for the estimated 1.9 billion Muslim people around the world, of which 150 million are estimated to have diabetes [1,2]. The month of Ramadan involves abstaining from eating and drinking between dawn and sunset and for people living with diabetes, fasting-related hypoglycaemia, hyperglycaemia and dehydration are common [2,3]. These complications pose considerable risk and breaking the fast due to diabetes-related illness is common [2,3]. Whilst exemptions are available for individuals with medical conditions, including those with diabetes, most choose to participate, often without or against medical advice [4]. Individualised fasting risk varies significantly [5,6], and hence, guidelines recommend pre-Ramadan education and counselling with a healthcare professional [7–10].

Diabetes self-management education aims to empower individuals to manage their health, navigate and self-advocate within their health systems and make better health choices [11]. Ramadan-focused diabetes education builds upon this in a Ramadan specific context with practical consideration for dietary changes and daytime fasting. It aims to i) enable an informed and shared fasting decision based on risk assessment, ii) facilitate safer fasting through self-monitoring advice, improved risk-awareness, and dietary and physical activity advice, iii) plan necessary medication adjustment, iv) safety net and signpost to ongoing support and v) provide opportunistic preventative healthcare [7]. Many studies have found Ramadan-focused diabetes education improves fasting experience and clinical outcomes, reducing acute complications (i.e., hypoglycaemia episodes) and improving glycaemic control [12,13]. However, the Diabetes and Ramadan (DAR) Global Survey of Ramadan fasting showed only 44% of those with type 2 diabetes and 60% of those with type 1 diabetes received Ramadan-focused diabetes education [2,3]. Notably, most respondents lived in Muslim majority countries where observing Ramadan is common.

In countries such as the UK where Muslims are a minority, access to Ramadan-focused diabetes education is likely poor. Healthcare professionals must be knowledgeable to deliver pre-Ramadan diabetes education, although such cross-cultural care can be challenging [14]. Given the religious importance of Ramadan, healthcare professionals who are not Muslim may be hesitant to counsel or deter individuals from fasting, particularly if the perceived best-interests of health and faith conflict [15]. Basic awareness of Islam and Ramadan are necessary amongst all healthcare professionals to provide equitable and culturally competent care, yet a knowledge gap exists, accompanied by a desire amongst healthcare professionals for education [16–18].

Digitisation has emerged as a promising solution to provide education at a scale, helping to meet the needs of the rapidly growing global diabetes population [19]. Massive open online courses (MOOCs) are an example, where structured educational content is sequentially released allowing large volumes of learners simultaneous access [20]. In healthcare, MOOCs have traditionally focused on healthcare professional education, although interest in and frequency of patient-focused MOOCs has increased [21]. MOOCs can be flexibly and opportunistically deployed at low-cost and provide access to subject matter experts [22]. Free access to MOOCs can democratise diabetes education, expanding their reach globally and benefitting individuals who reside in health systems with limited access to free or affordable education. Additionally, MOOCs can provide preventative healthcare aiming to depressurise stretched frontline services [23]. In diabetes education, MOOCs have been demonstrated in both type 1 and type 2 diabetes to be acceptable, engaging, and useful, associated with sustained self-reported improvements in health knowledge and self-management ability [24, 25].

Here, we report our experience of design, delivery, and evaluation of dual MOOCs, informed by a pilot, and delivered simultaneously in three languages, to deliver Ramadan-focused diabetes education to people with diabetes and healthcare professionals.

2. Methods

A diverse multidisciplinary stakeholder team was established to meet regularly and oversee activities related to the MOOC. This included representatives from the two co-lead organisations: MyWay Digital Health (https://mywaydigitalhealth.co.uk/) and the Diabetes and Ramadan International Alliance (https://daralliance.me/) in addition to collaborators from academic, health service, patient, and professional organisations.

2.1. Design

An overview of the dual MOOC structure including course steps and examples of course content is available in Supplementary Table S1 and Fig. 1 respectively. The course was developed on a custom web platform (https://ramadan.mydiabetes.com/) using LearnDash LMS (Michigan, USA), aligned to Web Content Accessibility Guidelines (WCAG) level AA. To access the MOOCs, users were required to register an account, allowing data collection and progress tracking. The MOOCs were free to access, provided users had a means of internet access. Content was aligned with guidance produced by the Diabetes and Ramadan International Alliance [7]. Content covered issues encountered whilst fasting with diabetes, focusing on risk assessment, dietary and physical activity advice, medication adjustment and glucose monitoring. Content and language were adapted to be relevant to people with diabetes or healthcare professionals in respective MOOCs. Content was presented as text, interactive and video formats featuring experience shared by people with lived experience of fasting during Ramadan and advice from multidisciplinary healthcare professionals. Language switching functionality was available on the patient MOOC, enabling switching of content between English, Arabic and Malay. Moderated discussion forums were available on each course page, for users to discuss content and engage in peer-support. Four live question and answer sessions with a panel of health professionals (including a diabetes specialist dietitian and a diabetologist/primary care physician with specialty interest in Ramadan) were delivered via a freely available video conferencing platform to augment course content and provide an opportunity to have questions answered and discuss matters arising in discussion forums. A personalised certificate was issued upon completion of 100% of course steps.

2.2. Adaptation based on a pilot MOOC

To achieve the design detailed in Supplementary Table S1, a user-centred iterative design process was adopted, beginning with a single pilot MOOC in 2022 entitled *Managing Diabetes During Ramadan*. This MOOC was delivered prior to and during Ramadan 2022 in English, Arabic and Malay and included videos, discussion forums and live question and answer sessions. This pilot served as an exploratory phase, offering an initial understanding of technical delivery, potential interest, and the MOOC's acceptability in delivering diabetes education specifically tailored for Ramadan. In addition to English, Arabic and Malay were chosen as available languages aiming to provide broad linguistic

coverage across Muslim majority regions of high diabetes prevalence, namely Asia-Pacific and Middle East-North Africa regions.

The pilot MOOC attracted 648 registrations [26]. Despite its primary target audience being Muslim individuals with diabetes, 69% of the registrants identified themselves as healthcare professionals. User feedback was positive, with >85% of users agreeing the MOOC was easy to follow, improved their diabetes knowledge and had the information the expected. User feedback was reviewed by the delivery team, and a proposal for adaptation for 2023 was developed. Primary adaptations related to i) bifurcation of the MOOC into a dual structure, with one course for people with diabetes and one course for healthcare professionals allowing for improved relevancy of education provided for each group, ii) redesign of the course evaluation surveys enabling a more thorough course evaluation and assessment of user demographics, iii) expansion of expertise and representation within the steering and course development group and iv) development of a multimodal dissemination strategy. This dissemination strategy included press releases from involved organisations and email and social media advertising through collaborating organisations and wider health authorities and diabetes and Muslim community organisations.

2.3. Evaluation

A mixed-methods evaluation approach was adopted. Course metrics including usage were collected automatically. After initial internal piloting to assess readability, pre- and post-course surveys (in English, Arabic and Malay) were embedded in introductory and final course steps. Demographic data were collected among users who opted-in to provide this in the pre-course survey. Likert style evaluation questions were administered to assess multiple domains relating to managing diabetes during Ramadan. Arabic and Malay survey responses were translated into English for analysis. Survey responses were summarised using descriptive statistics with "*agree*" and "*strongly agree*" Likert responses combined to assess agreeability. Where survey questions involved a paired pre- and post-course design a Wilcoxon sign-rank test was used to assess post-course changes under the assumption that Likert data were not normally distributed. $p < 0.05$ indicated statistical significance. Survey questions inviting free text responses, namely those relating to goal setting and general post-course feedback, were coded

and qualitatively analysed using NVivo 1.7.1. Ethical committee approval was not required for evaluation of the MOOC as data were collected for the purpose of service improvement.

3. Results

Promotional activities relating to the MOOCs resulted in televised news coverage in Scotland and radio coverage in England. Social media posts on twitter/X relating to the MOOCs had over 120,000 views. A total of 1531 users registered on the platform, of which 809 (53%) users started a course. Among course starters, 48% completed ≥60% of course steps (see Table 1). MOOC registrants provided their country of residence upon registration and 50 countries were represented; most users lived in southeast Asia (Malaysia), Middle Eastern states (Saudi Arabia and United Arab Emirates) and the United Kingdom (see Fig. 2). A total of 571 pre-course and 267 post-course survey responses were collected from consenting users. In the pre-course survey, users could optionally provide demographic information, a full breakdown of which is available in Supplementary Table S2 and Supplementary Table S3.

Users of the HCP MOOC worked within varied professional roles (including doctors, pharmacists, dietitians, nurses and health coaches), were mostly (60%) non-diabetes specialists and most (55%) identified as Muslim. They wished to improve their knowledge regarding dietary advice, medication management, and glucose monitoring to enable

Table 1
Course registration and completion statistics. Completion rates are calculated as a percentage of users who started a massive open online course (MOOC). Data for course type is not available at the point of initial platform registration.

	For healthcare professionals	For people living with diabetes	Total
MOOC registrants, n	-	-	1531
Started MOOC, n	549	260	809
≥60% Completion, n (%)	275 (50%)	112 (43%)	387 (48%)
100% Completion, n (%)	215 (39%)	85 (33%)	300 (37%)

Fig. 1. Mock of massive open online course (MOOC) content, displayed in smartphone and laptop formats. Mocks created using MockUPhone.
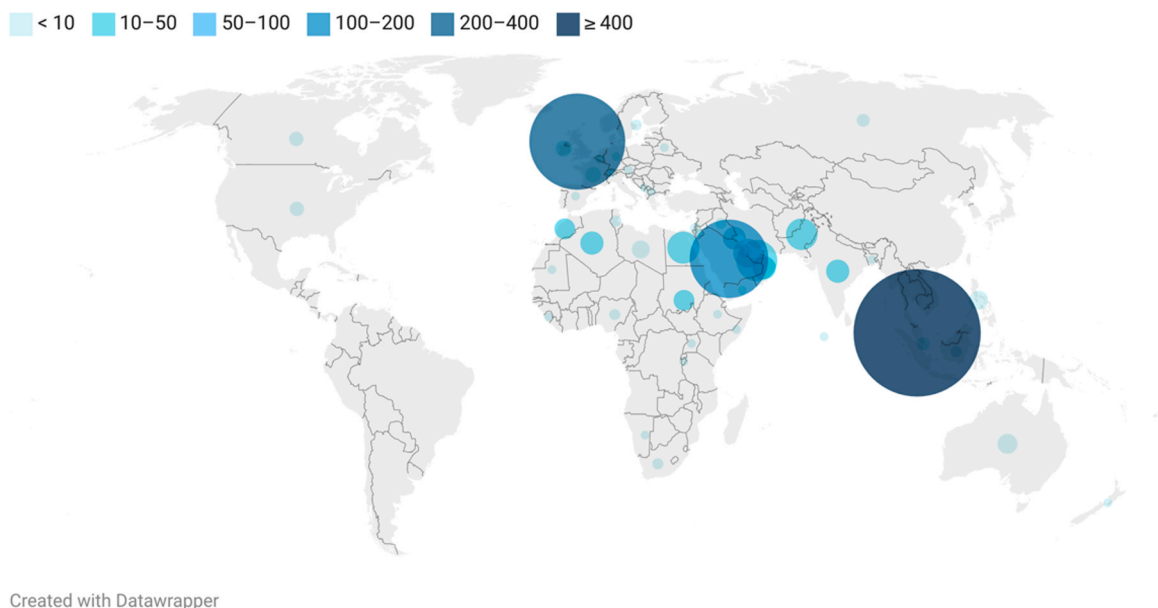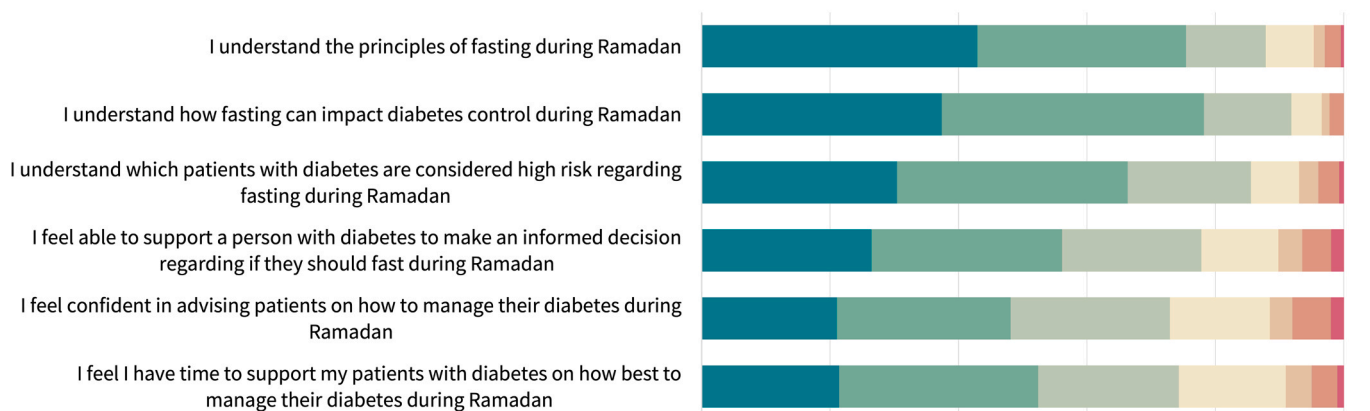
Created with Datawrapper

Fig. 2. World plot of user registrations based on n=1234 users that provided country of residence on registration. As depicted, most registrations were from users who lived in Malaysia, Saudi Arabia and the United Kingdom although many countries were represented. Plot created with Datawrapper.

them to deliver Ramadan-focused patient care. Many HCPs cited a lack of confidence in this area and non-Muslim HCPs particularly felt their advice was not authoritative in the context of Ramadan. Users recognised mostly time constraints and lack of motivation as barriers to achieving their goals. Responses to pre-course Likert questions are presented in Fig. 3. High pre-course diabetes and Ramadan awareness, understanding and management confidence was evident among users in

the HCP MOOC. Notably, higher agreeability was observed across the six statements assessed among users who identified as Muslim compared to those who did not (Supplementary Figure S1). Among HCP MOOC users who had paired pre- and post-course question responses to the six questions presented in Fig. 3A (n=197–199 responses per statement), increased post-course agreeability was observed across all six statements (p<0.01).

A. HCP MOOC

B. Patient MOOC

■ Strongly agree ■ Agree ■ Somewhat agree ■ Neutral ■ Somewhat disagree ■ Disagree ■ Strongly disagree
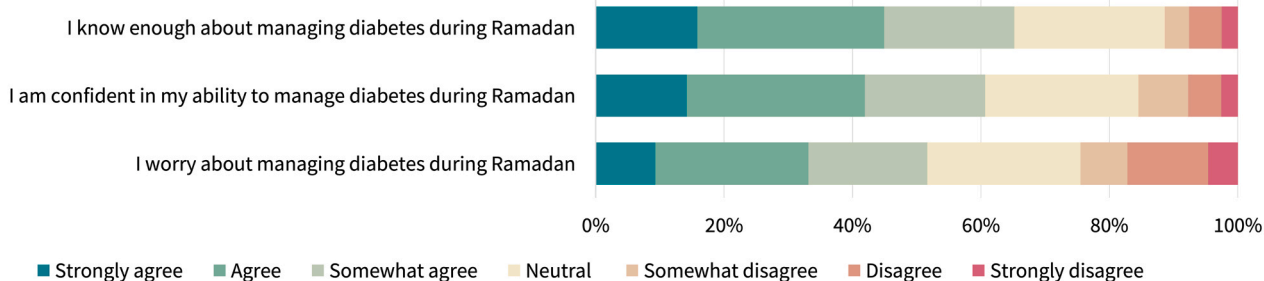
Fig. 3. Baseline self-reported agreeability to Ramadan knowledge, impact and management statements among users participating in the A. HCP MOOC (n=397–404 responses per statement) and B. Patient MOOC (n=151–158 responses per statement).

A limited number of people with diabetes opted-in to providing demographic data (Supplementary Table S3). Available data showed 75% of users were female and 81% were Muslim with a mean age of 41 years; although most had diabetes, family members and carers of people with diabetes were also represented. Less than half (46%) of users confirmed they had experienced Ramadan-focused diabetes education previously. A total of 46% of users had fasted during Ramadan whilst having diabetes previously, and among this group, 60% previously found it difficult and 43% felt they had adequate support from their healthcare professional at the time. Users of the MOOC for people with diabetes wanted to increase their knowledge of managing their diabetes during Ramadan and spoke about doing this in relation to diet, fasting and managing blood sugar levels.

Among responses in the patient MOOC at baseline, 65% and 61% of users agreed they knew enough and were confident to manage diabetes during Ramadan. Notably, 52% of users in the patient MOOC reported they worried about managing diabetes during Ramadan. Among paired responses (n=51–55 responses per statement), post-course agreeability improved for statements relating to diabetes and Ramadan health knowledge and management confidence (p<0.01), but responses to the statement "*I worry about managing my diabetes during Ramadan*" were overall unchanged. Over 95% of users who completed the MOOCs and completed the post-course surveys agreed the course was useful, easy to follow and would help them manage diabetes during Ramadan (see Fig. 4).

Qualitative analysis of general course feedback showed users in both MOOCs liked the presentation which made the courses 'easy to understand' "Keterangan yang diberikan adalah jelas" ["The information provided is clear"]. Embedded video content was well-received by users, who appreciated the personal stories and connections relayed through patient incorporation. The course was seen as an authoritative resource by many participants; many users acknowledged the credibility of the course as a reliable and up-to-date source of information and guidance. A notable number of HCPs also chose to enrol in the patient course. Several HCPs and one patient expressed a preference for having the course materials available as a downloadable PDF. Although a certificate was available upon course completion, many users would have

preferred the course have formal accreditation. Users with diabetes requested further depth in specific areas of the course, such as medication, hypoglycaemia management, diet, meal planning, and blood sugar control.

4. Discussion

We demonstrate successful delivery of a novel platform delivering a first-of-its-kind MOOC for Ramadan-focused diabetes education. The MOOC engaged a diverse, multilingual, international cohort of learners who, overall, experienced immediate post-course improvements in their diabetes and Ramadan knowledge and management confidence. The social, participatory, and community-centred approach employed by the MOOC enables harnessing of the many documented benefits and peer-support of the online diabetes community, whilst reducing misinformation risk through active moderation and assured educational quality [27]. Although we hope this education will translate into improved awareness and clinical handling of diabetes care during Ramadan, determination of sequential impact is challenging, due to our real-world, scaled delivery limiting assessment of linked clinical outcomes. Nonetheless, we hope that the awareness-raising element of this project alone will have encouraged people with diabetes to consider how fasting may impact their diabetes, and motivated HCPs to reflect on their preparedness to deliver equitable and culturally competent diabetes care during Ramadan.

Guidelines recommend pre-Ramadan counselling with an HCP for people with diabetes who wish to fast [7–10], yet a minority of users in the patient MOOC had previously experienced Ramadan-specific diabetes education, and those who had previously fasted with diabetes found it a difficult and unsupported experience. The volume of registrations demonstrates an interest in Ramadan-focused diabetes education and that innovative mechanisms such as this course have the potential to capture interest and educate at scale. We particularly identify a need to equip non-Muslim HCPs with the knowledge and confidence needed to engage in discussions relating to Ramadan. Counselling around cultural and religious issues in relation to health are clearly challenging, and non-Muslim HCPs recognised that they lacked
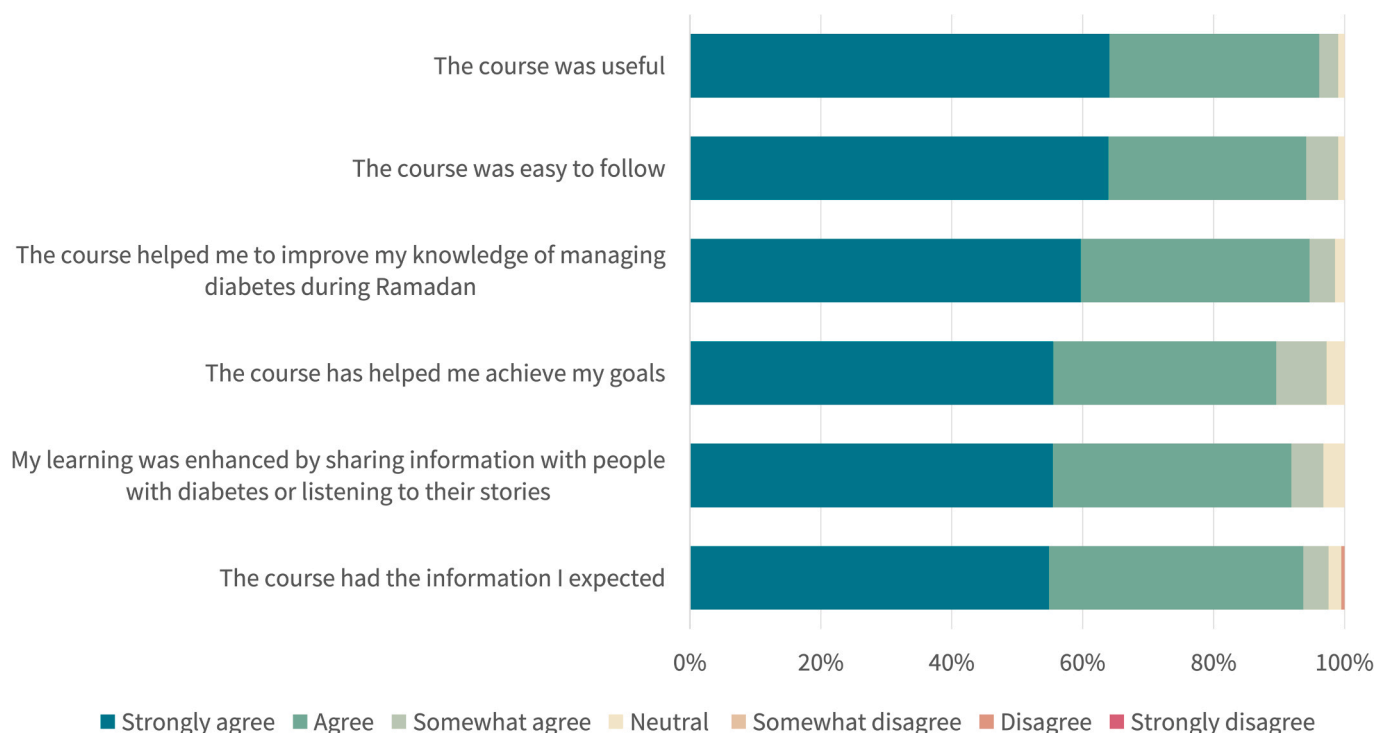

Fig. 4. Overview of course experience questions from both MOOCs (n=182–206 responses per statement).

authority in this area. Our data were unable to explain if this discomfort was underpinned solely by a lack of knowledge, or if it was more entwined with cultural and religious nuances that HCPs recognise they may not completely understand. Interview-based research techniques would be helpful to further understand and guide future interventional approaches, where directly addressing such discomfort through experience sharing may be beneficial.

Like many diabetes educational interventions, our program faces a significant challenge in engaging those who are stand to benefit the most [28]. This challenge is evident in the high levels of self-reported knowledge and awareness observed in pre-course survey responses across both courses. These responses likely indicate a self-selected, highly educated, and motivated participant pool. While we aimed to maximize accessibility, the online-only delivery may inadvertently exclude individuals with limited digital access or literacy. Despite high registration numbers during the promotional period, a substantial proportion of registrants did not participate with the course content, although our completion rates surpass average MOOC completion rates of 5–10% [29]. To accommodate a diverse range of participants, we promoted flexible participation and made no aspect of the course mandatory which we expect impacts completion rates. We recognised that certain topics, such as medication management for non-prescribing HCPs or hypoglycaemia management for those not taking specific medications, are not applicable to all users. However, our study is limited by our inability to analyse the experiences of many participants who did not complete the course. Our findings underscore the fact that a single approach to Ramadan education may not be universally effective. Whilst we plan to re-deliver an improved version of our MOOC in the coming years, we urge other groups to develop complementary educational programs with varied delivery mechanisms to improve reach.

In our ongoing efforts for improvement, we have identified several strategies informed by this experience and user feedback that we believe will enhance effectiveness and inclusivity, with a primary focus on UK-based Muslim communities and HCPs. Originally, our course content, including the languages offered, was primarily oriented towards Middle Eastern and South Asian Muslim communities, as reflected in the dietary guidelines, patient narratives, and visual elements. We plan to divide components of the course where cultural needs differ, such as dietary information, to deliver relevant and representative education tailored to distinct Muslim ethnic subgroups. By incorporating culturally pertinent dietary advice, imagery, and patient experiences that resonate with key ethnic groups, we aim to foster a more relevant and inclusive learning environment [30]. Simultaneously, subject to funding we plan to broaden accessibility by adding more languages commonly spoken in Muslim communities, like Urdu and French. Deepening our partnership with community health and faith groups will be crucial in refining our design and promotional strategies to improve engagement and deliver a valuable intervention. The MOOC's scalable and low-cost delivery mechanism could offer substantial impact; we hope that it not only amplifies awareness but also furthers the equity in the delivery of diabetes care.

Funding

CRediT authorship contribution statement

SCM drafted the manuscript. SCM, SM, BNMY, HSB, KMC, TTF, MH and DJW contributed to conception and design of this project and study. SM, BNMY, KCM and DJW led MOOC content development and design. KCM, TTF, SCM contributed to technical delivery of the MOOC. KCM, SM, BNMY, AA, HSB, TTF, SW, MH and SJW contributed to delivery of live question and answer sessions. BA is a patient representative. JD led

the qualitative analysis. SCM, JD and MSB contributed to survey design. All authors critically reviewed and provided feedback on the final manuscript.

Conflict of interest

SCM, AB, KMC, TTF are employees of MyWay Digital Health. DJW is a co-founder and shareholder of MyWay Digital Health Limited.

Acknowledgments

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.pcd.2024.03.002.

References

[1] Pew Research Centre. The Future of the Global Muslim Population. 2011. ⟨https://www.pewresearch.org/religion/2011/01/27/the-future-of-the-global-muslim-population/⟩.

[2] M. Hassanein, Z. Hussein, I. Shaltout, W.J. Seman, C.V. Tong, N.M. Noor, M.A. Buyukbese, L. El Tony, G.M. Shaker, R.M. Alamoudi, K. Hafidh, The DAR 2020 Global survey: Ramadan fasting during COVID 19 pandemic and the impact of older age on fasting among adults with Type 2 diabetes, Diabetes Res. Clin. Pract. 173 (2021 Mar 1) 108674.

[3] M. Hassanein, R.M. Alamoudi, M.A. Kallash, N.J. Aljohani, E.M. Alfadhli, L. El Tony, G.S. Khogeer, A.F. Alfadhly, A.E. Khater, M.Y. Ahmedani, M.A. Buyukbese, Ramadan fasting in people with type 1 diabetes during COVID-19 pandemic: the DaR Global survey, Diabetes Res. Clin. Pract. 172 (2021 Feb 1) 108626.

[4] S. Bouchareb, R. Chrifou, Z. Bourik, G. Nijpels, M. Hassanein, M.J. Westerman, P.J. Elders, I am my own doctor": A qualitative study of the perspectives and decision-making process of Muslims with diabetes on Ramadan fasting, Plos One 17 (3) (2022 Mar 4) e0263088.

[5] S.K. Noor, T.A. Mo'min, F.A. FadAllah, A.A. Ahmed, S.A. Osman, S. Badi, A.I. Fathelrahman, M. Ahmed, M.H. Ahmed, Risk factors associated with fasting during Ramadan among individuals with diabetes according to IDFDAR risk score at Atbara city. Sudan: Cross-sectional hospital-based study. Diabetes & Metabolic Syndrome: Clinical Research & Reviews, 2023 Mar 12 102743.

[6] N. Ghouri, S. Hussain, S.H. Ahmed, S.A. Beshyah, R. Rashid, E. Al-Ozairi, S. Waqar, A. Dabhad, R. Mohammed, Changing how we risk-categorise in Ramadan: does the IDF-DAR scoring system achieve the requirements for people with diabetes internationally? Diabetes Res. Clin. Pract. 175 (2021 May 1) 108835.

[7] M. Hassanein, B. Afandi, M.Y. Ahmedani, R.M. Alamoudi, F. Alawadi, H.S. Bajaj, A. Basit, A. Bennakhi, A.A. El Sayed, O. Hamdy, W. Hanif, Diabetes and Ramadan: practical guidelines 2021, Diabetes Res. Clin. Pract. (2022 Jan 8) 109185.

[8] S.H. Ahmed, T.A. Chowdhury, S. Hussain, A. Syed, A. Karamat, A. Helmy, S. Waqar, S. Ali, A. Dabhad, S.T. Seal, A. Hodgkinson, Ramadan and diabetes: a narrative review and practice update, Diabetes Ther. 11 (2020 Nov) 2477–2520.

[9] British Islamic Medical Association. Ramadan Compendium. 2023. ⟨https://britishima.org/guide/ramadan-compendium/⟩.

[10] M. Al-Arouj, S. Assaad-Khalil, J. Buse, I. Fahdil, M. Fahmy, S. Hafez, M. Hassanein, M.A. Ibrahim, D. Kendall, S. Kishawi, A. Al-Madani, Recommendations for management of diabetes during Ramadan: update 2010, Diabetes care 33 (8) (2010 Aug) 1895.

[11] M.A. Powers, J. Bardsley, M. Cypress, P. Duker, M.M. Funnell, A.H. Fischl, E. Vivian, Diabetes self-management education and support in type 2 diabetes: a Joint Position Statement of the American Diabetes Association, the American Association of Diabetes Educators, and the Academy of Nutrition and Dietetics, J. Acad. Nutr. Diet. 115 (8) (2015) 1323–1334.

[12] S.H. Ahmed, T.A. Chowdhury, S. Hussain, A. Syed, A. Karamat, A. Helmy, S. Waqar, S. Ali, A. Dabhad, S.T. Seal, A. Hodgkinson, Ramadan and diabetes: a narrative review and practice update, Diabetes Ther. 11 (2020 Nov) 2477–2520.

[13] A.M. Tourkmani, O. Abdelhay, T.J. Alharbi, A.M. Bin Rsheed, M. Azmi Hassali, A.A. Alrasheedy, M.M. Hassanein, Y.K. Alotaibi, A.M. AlShowair, W. AlMadani, A.M. Alrabiah, Impact of Ramadan-focused diabetes education on hypoglycemia risk and metabolic control for patients with type 2 diabetes mellitus: a systematic review, Int. J. Clin. Pract. 75 (3) (2021 Mar) e13817.

[14] J.K. King, A. Kieu, M. El-Deyarbi, N. Aljneibi, S. Al-Shamsi, M.J. Hashim, L. Östlundh, K.E. King, R.H. King, M.A. Khan, R.D. Govender, Towards a better understanding between non-Muslim primary care clinicians and Muslim patients: a literature review intended to reduce health care inequities in Muslim patients, Health Policy OPEN (2023 Mar 24) 100092.

[15] T.E. Yılmaz, E. Başara, T. Yılmaz, İ. Kasım, A. Özkara, Approaches and awareness of family physicians on diabetes management during Ramadan, Int. J. Clin. Pract. 75 (7) (2021 Jul) e14205.

[16] H.A. Almansour, B. Chaar, B. Saini, Fasting, diabetes, and optimizing health outcomes for Ramadan observers: a literature review, Diabetes Ther. 8 (2017 Apr) 227–249.

[17] W. Hanif, V. Patel, S.N. Ali, A. Karamat, M. Saeed, M. Hassanein, A. Syed, T. A. Chowdhury, A. Farooqi, K. Khunti, The South Asian health Foundation (UK) guidelines for managing diabetes during Ramadan, Diabetes Res. Clin. Pract. 164 (2020 Jun 1) 108145.

[18] S. Waqar, N. Ghouri, R. Awaad, Chronic disease management during Ramadan, Am. Fam. Physician 107 (2) (2023 Feb) 125–126.

[19] Ong K.L., Stafford L.K., McLaughlin S.A., Boyko E.J., Vollset S.E., Smith A.E., Dalton B.E., Duprey J., Cruz J.A., Hagins H., Lindstedt P.A. Global, regional, and national burden of diabetes from 1990 to 2021, with projections of prevalence to 2050: a systematic analysis for the Global Burden of Disease Study 2021. The Lancet. 2023 Jun 22.

[20] R. Moe, The brief & expansive history (and future) of the MOOC: why two divergent models share the same name, Curr. Issues Emerg. elearning 2 (1) (2015) 2.

[21] W.D. Maxwell, P.H. Fabel, V. Diaz, J.C. Walkow, N.C. Kwiek, S. Kanchanaraksa, M. Wamsley, A. Chen, P.B. Bookstaver, Massive open online courses in US healthcare education: practical considerations and lessons learned from implementation, Curr. Pharm. Teach. Learn. 10 (6) (2018 Jun 1) 736–743.

[22] S.C. Mackenzie, K.M. Cumming, D. Garrell, D. Brodie, L. Wilson, S. Mehar, S. G. Cunningham, A. Bickerton, D.J. Wake, Massive open online course for type 2 diabetes self-management: adapting education in the COVID-19 era, BMJ Innov. 7 (1) (2021 Jan 1).

[23] G. Irving, A.L. Neves, H. Dambha-Miller, A. Oishi, H. Tagashira, A. Verho, J. Holden, International variations in primary care physician consultation time: a systematic review of 67 countries, BMJ Open 7 (10) (2017 Oct 1) e017902.

[24] S.C. Mackenzie, K.M. Cumming, D. Garrell, D. Brodie, L. Wilson, S. Mehar, S. G. Cunningham, A. Bickerton, D.J. Wake, Follow-up of a massive open online course in type 2 diabetes self-management education, J. Diabetes Sci. Technol. 15 (4) (2021 Jul) 976–977.

[25] S.C. Mackenzie, K.M. Cumming, S. Mehar, L. Wilson, S.G. Cunningham, A. Bickerton, D.J. Wake, Education at scale: Improvements in type 1 diabetes self-management following a massive open online course, Diabet. Med. 39 (8) (2022 Aug) e14842.

[26] S. Mehar, S.C. Mackenzie, T. Flax, B. Mohd-Yusof, M. Hassanein, N. Lessan, E. Al Ozairi, F. Ismail, M. Suliman, M. Ibrahim, L.L. Lim, D.J. Wake, Diabetes and Ramadan: facilitating safer fasting through self-management education via an open online course. International Diabetes Federation World Congress, Lisbon (2022), https://doi.org/10.13140/RG.2.2.16434.68806.

[27] M.L. Litchman, H.R. Walker, A.H. Ng, S.E. Wawrzynski, S.M. Oser, D. A. Greenwood, P.M. Gee, M. Lackey, T.K. Oser, State of the science: a scoping review and gap analysis of diabetes online communities, J. Diabetes Sci. Technol. 13 (3) (2019 May) 466–492.

[28] I. Tapager, K.R. Olsen, K. Vrangbæk, Exploring equity in accessing diabetes management treatment: a healthcare gap analysis, Soc. Sci. Med. 292 (2022 Jan 1) 114550.

[29] D. Davis, I. Jivet, R.F. Kizilcec, G. Chen, C. Hauff, G.J. Houben, Follow the successful crowd: raising MOOC completion rates through social comparison at scale, InProceedings Seven-.-. Int. Learn. Anal. Knowl. Conf. 13 (2017 Mar) 454–463.

[30] S. Brown-Jeffy, J.E. Cooper, Toward a conceptual framework of culturally relevant pedagogy: An overview of the conceptual and theoretical literature, Teach. Educ. Q. 38 (1) (2011 Jan 1) 65–84.