Diabetes and Migration

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NOTICE OF UPDATE

The DDG practice recommendations are updated regularly during the second half of the calendar year. Please ensure that you read and cite the respective current version.

UPDATES TO CONTENT AND DIFFERENT RECOMMENDATIONS COMPARED TO THE PREVIOUS YEAR'S VERSION

Recommendation 1: Update of data on the population group with a migration background (see point 1.3 Demographics for Germany).
Reason: There is more recent data on demographics for Germany.
Supporting references: [9, 11]
Recommendation 2: Data from 2019 show that the use of systems for continuous glucose monitoring (CGM) is 30 % more common in patients without a migration background than in those with a migration background [41] (see point 1.7.2 Particularities in the therapy).
Reason: New insights into the use of digital supporting tools in diabetes therapy and blood glucose control.
Supporting references: [38]
Recommendation 3: Update of the effectiveness of common diabetes medications such as alpha-glucosidase inhibitors (acarbose) and insulin.
Reason: New findings on the effectiveness of common diabetes drugs in people of non-European origin.
Supporting references: [42]
Recommendation 4: New data on the increasing use of online translation services in healthcare (see point 1.8.2 Language)
Reason: The importance of online translation services is also growing in healthcare and diabetes treatment for people with migration experience.
Recommendation 5: Prevention of diabetes mellitus and its secondary diseases were included (see point 1.11 Prevention)
Reason: To date, the therapeutic approaches and specificities of diabetes mellitus in people of non-German origin have mainly been discussed. The revised edition now also takes into account the prevention of diabetes mellitus and its complications.
Recommendation 6: Expansion and updating of the topic of fasting in people with type 1 diabetes (see point 1.13 Ramadan – One Month of Fasting)
Reason: New insights into the possibility of fasting in people with type 1 diabetes mellitus and with the help of certain drug regimens.
Supporting references: [93, 97]

The practical recommendation "Diabetes and Migration" of the German Diabetes Association (DDG) was prepared for the first time and in cooperation with the Austrian Diabetes Association (ÖDG). The practice recommendation is intended to supplement the existing guidelines on diabetes mellitus and provides practical recommendations for the diagnosis, therapy and care of people with diabetes mellitus who come from different linguistic and cultural backgrounds.

Definition (migration background and generation)

The population with a migration background includes people with their own migration experience and all those who have at least one parent or grandparent to whom this applies [1]. Different definitions or changes in what is understood by a migrant background make it difficult to have a uniform and consistent view [2].

In the context of therapy, in addition to the pure migration background, the generational affiliation or the place of socialization plays an important role:

- First generation: socialization took place in the country of origin and immigration took place in adulthood.
- Second generation: children of the first generation born here or whose family moved here when they were under 18 years old. Their socialization has taken place, at least in part, in Germany.
- Third generation: first-generation grandchildren and second-generation children. Their socialization has taken place entirely in Germany.

Epidemiological overview

In many official statistics and routine data, nationality is still considered the predominant distinguishing feature, which is used to represent only a selective part of the migrant population, however socio-demographic information is missing. People with a migration background often differ in their health situation from people without a migration background simply because of their younger average age or their poorer social situation. To make meaningful comparisons, the influence of these factors must be taken into account [2].

Despite an incomplete data situation in Germany, studies from similar countries make it possible to obtain an approximate picture of the situation in Germany. It is estimated that more than 600 000 people with type 2 diabetes and with a migration background live in Germany today. This number will continue to grow in the coming years for two main reasons. Firstly, the first generation of migrants is increasingly reaching retirement age and secondly, many of the refugees coming to Germany come from countries with a high risk of developing type 2 diabetes. This risk is increased when they migrate to industrialized countries [3].

Demographics for Germany

Currently, the microcensus is the only available official source of data on the population group with a migration background. In 2020, the microcensus was methodologically revised. Therefore,

the results from the reporting year 2020 and onwards can only be compared with previous years to a limited extent [4].

In 2021, about 22.3 million (27.2 %) people in Germany had a migration background. This represented an increase of 2.0 % compared to the previous year. The most important countries of origin continue to be Turkey (12 %), followed by Poland (10 %), Russia (7 %), Kazakhstan (6 %) and Syria (5 %) [5].

Almost two-thirds (62 %) of all persons with a migrant background are immigrants from other European countries or their descendants. This corresponds to 13.9 million people, 7.5 million of whom have roots in other Member States of the European Union. The second most important region of origin is Asia. 5.1 million immigrants from Asia and their descendants account for 23 % of people with a migrant background; of these, 3.5 million have a connection to the Near and Middle East. Almost 1.1 million people (5 %) have roots in Africa. Another 0.7 million people (3 %) are immigrants from North, Central and South America and Australia and their descendants [5].

Of the 22.3 million people with a migrant background, 7.2 million (32 %) speak exclusively German at home and an additional 3.1 million (14 %) predominantly German. This corresponds to almost half (46 %) of all people with a migration background. The most frequently used languages in addition to German are Turkish (8 %), Russian (7 %) and Arabic (5 %). Almost half (49 %) of all people with a migrant background are multilingual and speak both German and (at least) one other language at home. This applies to only 2 % of people without a migrant background [6].

The associated particularities of the population structure confer greater cultural diversity for the German society. At the same time, this population structure poses challenges on the health care system.

Prevalence for Germany

The risk of developing type 2 diabetes varies greatly among migrant populations. People from South and Central America, North and Sub-Saharan Africa, the Middle East and South Asia have very high prevalences [7].

Numerous European and American studies confirm that the prevalence and incidence of type 2 diabetes and its associated mortality are usually higher among migrants than among the native population [8]. In addition, migrants experience type 2 diabetes on average 5–10 years earlier and are more likely to develop the disease than the populations in their home countries and in the host countries [3, 9].

A recent meta-analysis of the prevalence of ethnic minorities in Europe shows that migrants from South and Central America show a 30 % higher risk than the native population. In contrast, the risk is almost three times higher for migrants from the Middle East and North Africa and almost four times higher for migrants from South Asia [10–12].

Women of Turkish origin in Sweden have a 3-times higher risk of diabetes compared to Swedish women, whereas there is hardly any difference between Turkish men and Swedish men. This is the same for the hospitalization risk due to type 2 diabetes, although this effect is reduced in the second generation [13]. A study conducted in 7 European countries for 30 immigrant groups shows that the diabetes mortality rate for men and women is 90 and 120 % higher, respectively, compared to the native population [14]. In addition, people with type 2 diabetes from Asia, the Middle East and Sub-Saharan Africa have a particularly high risk of microvascular complications: diabetic retinopathy, nephropathy, and peripheral neuropathy [15].

Increased disease rates are also seen for gestational diabetes. In Germany, for example, women of Turkish origin have a 33 % higher incidence rate of gestational diabetes compared to autochthonous population [16].

Demographics for Austria

According to Statistics Austria, 8.9 million people live in Austria, of which a total of 2.24 million have a migrant background. This is 51 900 more than in 2017, which represents a share of about 25.4 % [17]. The group of first-generation immigrants comprises about 1 528 000 persons, while second-generation immigrants amount to around 542 000. The largest group comes from Germany with 217 000 persons, followed by 138 000 Romanians. In the course of 2019, these have overtaken Serbian (122 100) and Turkish citizens (117 600). Bosnia and Herzegovina occupy fifth place (96 600). The citizens of Hungary, Croatia, Poland, Syria and Afghanistan are in sixth to tenth place. In addition, migrants from Slovakia, Russia, Italy, Bulgaria, Kosovo, and Macedonia are also strongly represented in Austria [17]. Since February 2022, an increasing number of people have been fleeing from the Ukraine to Germany and Austria. Therefore, the treatment of this population group will become relevant.

Prevalence for Austria

In Austria, the group of people suffering from diabetes mellitus is currently estimated at 515 000 to 809 000 people (7 to 11 %). The total includes 368 000 to 515 000 medically-diagnosed diabetes cases (approx. 5 to 7 %) and an estimated 147 000 to 294 000 diabetics (approx. 2 to 4 %). In the group of 0 to 14-year-olds, the estimated proportion of people with diabetes is about 0.1% in Austria (approx. 1600 children) [18]. According to the IDF (International Diabetes Federation), the prevalence of diabetes in Austria is 9.3 %. Among migrants, the prevalence is about 10–12 %, although a high number of unrecorded and undiagnosed patients is assumed [19]. In Vienna, a patient survey confirmed a diabetes prevalence of 10 % among Turkish migrants. Every third respondent had an increased risk of developing diabetes within the next five years [20]. Compared to native Austrians, migrants are 1.39 times more likely to develop diabetes among men and 3.4 times more likely among women [21].

Specifics in the diagnosis and therapy of migrants with diabetes

Due to their different cultural and individual backgrounds (level of education, reason and duration of migration, etc.), migrants often have a different understanding of health, healthcare, illness – especially chronic illness – than the native population. Knowledge of

the connections between lifestyle and disease, and of factors influencing the course of the disease can also differ from that of the native population [22]. In addition, lifestyle and particularly nutritional habits change as a result of the new social and economic conditions. Furthermore, external risk factors – structural deprivation – play an important role: these include location-specific (e. g. high unemployment), psychosocial (e. g. insecure employment conditions) and environmental (e. g. noise, air pollution, climate change, etc.) factors [23].

The cultural background and in some cases a lack of language skills, illiteracy, low socio-economic status and difficulties in the process of cultural adaptation (acculturation) can therefore hinder access to medical preventative care and treatment. This is also reflected in the low percentage of migrants who seek preventative medical checkups [24].

Specifics in diagnostics

Various changes can influence or falsify the HbA_{1c} value in immigrants and their offspring [25, 26].

The average HbA_{1c} value is higher for Americans of African descent than for Americans of European descent. The same applies to population groups from Sub-Saharan Africa compared to European populations [27–29]. Among adults in South Africa, the sensitivity and specificity of HbA_{1c} for the detection of prediabetes are extremely poor [30]. Therefore, $HbA_{1c} \geq 6.0\%$ has been proposed as a new diagnostic cut-off for this population group [31].

The Inuit have significantly higher HbA_{1c} values than Danish individuals for any given fasting and 2 h glucose value and for each category of glucose tolerance [32]. Further research is needed to find the optimal ethnically-specific interface for screening [33].

Causes of the observed ethnic differences include frequent hematological changes in these population groups. Iron deficiency (ID) is associated with up to 2 % increased HbA_{1c} in the absence of hyperglycemia. It is recommended to consider iron levels when interpreting HbA_{1c} in African populations [27, 34].

Hemoglobinopathies are the most common inherited single-gene disorders. According to the WHO, 5.2 % of the world's population carries a variant [35].

HbS (sickle cell trait) occurs frequently in Africa, the Mediterranean, the Near East and India. This results in a shortening of the erythrocyte lifetime. The HbA_{1c} value may be falsely higher due to this shortened lifetime [35]. However, due to structural changes in the globin molecule, decreased HbA_{1c} values can also be measured [28].

HbE is a hemoglobin variant with a mutation in the beta-globin gene, the most common Hb variant in Southeast Asia. Statistically and clinically significantly-higher results are observed due to the presence of the HbE trait [32].

HbB (changes in the beta-globin gene): β thalassemias occur more frequently in the Mediterranean, Southeast Asia, India, China and the Middle East. In southern Africa, one in three has some form of α thalassemia; in South-East Asia it is more than 60 % of the population [36]. The G202A variant in the X-linked gene of glucose-6-phosphate dehydrogenase (G6PD) also has a T allele frequency of 11 % in African Americans and up to 25 % in populations from Sub-Saharan Africa; it is associated with an absolute decrease in HbA_{1c} of 0.81 % units (95 % CI 0.66–0.96) per allele in hemizygous men and 0.68 % units (95 % CI 0.38–0.97) in homozygous women compared to homozygous carriers of the A allele [34].

Specifics in the therapy

There is evidence that therapy differs depending on cultural affiliation. For example, a study in the UK showed that an escalation of therapy in the course of treatment for diabetes mellitus occurs much less frequently in people of dark skin and South Asians than in the white population [37]. The reasons for this have not yet been sufficiently investigated, but the causes are likely multi-factorial. An important factor seems to be the lack of permanent medical care. Generally, the frequency of prescription of SGLT2 inhibitors has increased. However, this is not seen for patients with heart failure, kidney disease and cardiovascular disease. The drug was prescribed less in the population from sub-Saharan Africa, women, and households with lower income [38].

Further results suggest that standardized care may reduce existing ethnic inequalities in type 2 diabetes-associated chronic kidney disease (CKD) [39]. For example, an accelerated decline in the glomerular filtration rate was found in people of non-European origin who already had proteinuria and high blood pressure [40]. However, a randomized controlled trial showed that participants of African descent developed CKD less frequently than European participants, although both groups had similarly high levels of microalbuminuria, macroalbuminuria and kidney failure [39]. The authors attribute this to active monitoring of kidney function and emphasize that younger adults may benefit most from the interventions [40].

Data from 2019 show that the use of systems for continuous blood glucose monitoring (CGM) is 30 % more common in patients without a migration background than in those with a migration background [41]. The proposed reason is the lack of language settings of the CGM systems used for the languages of the largest immigration groups in Germany. Extending the language offer to Turkish, Russian and Arabic would be very useful. Furthermore, CGM systems and flash glucose systems are not fully covered by the health insurance schemes in Germany, and patients therefore have to co-pay approx. 10 € per month. This constitutes an additional hurdle for the use of these systems among migrant groups. In Austria, the financial contribution to GCM systems and flash glucose systems varies according to the health insurance company.

Particularities in substance selection

For pharmacological background information on the drugs listed below, we refer the readers to the specialist literature or summary of product characteristics. Here, we only discuss the migration-related specifics that are known scientific literature. At this point, only the differences in migration medicine known from studies are discussed.

Metformin: Efficacy may be reduced in Asians as a result of gene polymorphisms [42, 43].

DPP-4 inhibitors: a systematic review found that DPP-4 inhibitors are more effective in Japanese than in non-Japanese and are generally more effective in Asians than in non-Asians [42, 44].

GLP-1 agonist: In a meta-analysis (15 studies), it was shown that GLP-1 agonist lower the HbA_{1c} value in Asians more than in non-Asians [45]. The pharmacokinetic data of dulaglutide does not dif-

fer depending on ethnicity, weight, sex and age [46]. Semaglutide treatment results in a uniform reduction in HbA_{1c} without differences in origin or ethnicity (sustain post-hoc analyses) [47].

SGLT2-inhibitors: In the subgroup of people from Asia with type 2 diabetes mellitus, the EMPA-REG study showed the same positive effects (mainly a reduction in the incidence and progression of nephropathy) as in the remainder of the study population. There were also no significant differences to people of African descent [48].

Alpha-glucosidase inhibitors (acarbose):

In a meta-analysis, there were no differences in HbA_{1c} reduction between Asians and non-Asians [42].

Insulin:

A meta-analysis showed a lower HbA_{1c} reduction in Asians receiving insulin therapy (glargine) than in non-Asians, with no differences in hypoglycemia and fasting blood glucose [42].

Treatment of people with migration background and diabetes in practice

General approaches

The goals in the treatment of people with a migration background and diabetes are to enable an optimal transfer of knowledge and to strengthen the patients' personal responsibility. Appropriate information events are useful in order to increase knowledge about diabetes mellitus, the secondary and concomitant diseases as well as the relationship between the disease, diet and lifestyle. Starting points for this can be found in the respective communities with the involvement of all interest groups (such as cultural associations, religious communities, health insurance companies, medical societies, media).

In the inpatient and outpatient sector – particularly in practices specializing in diabetology – a culturally-sensitive approach with appropriately trained personnel (with special knowledge and understanding of the cultural influence on treatment) is an important prerequisite for successful therapy.

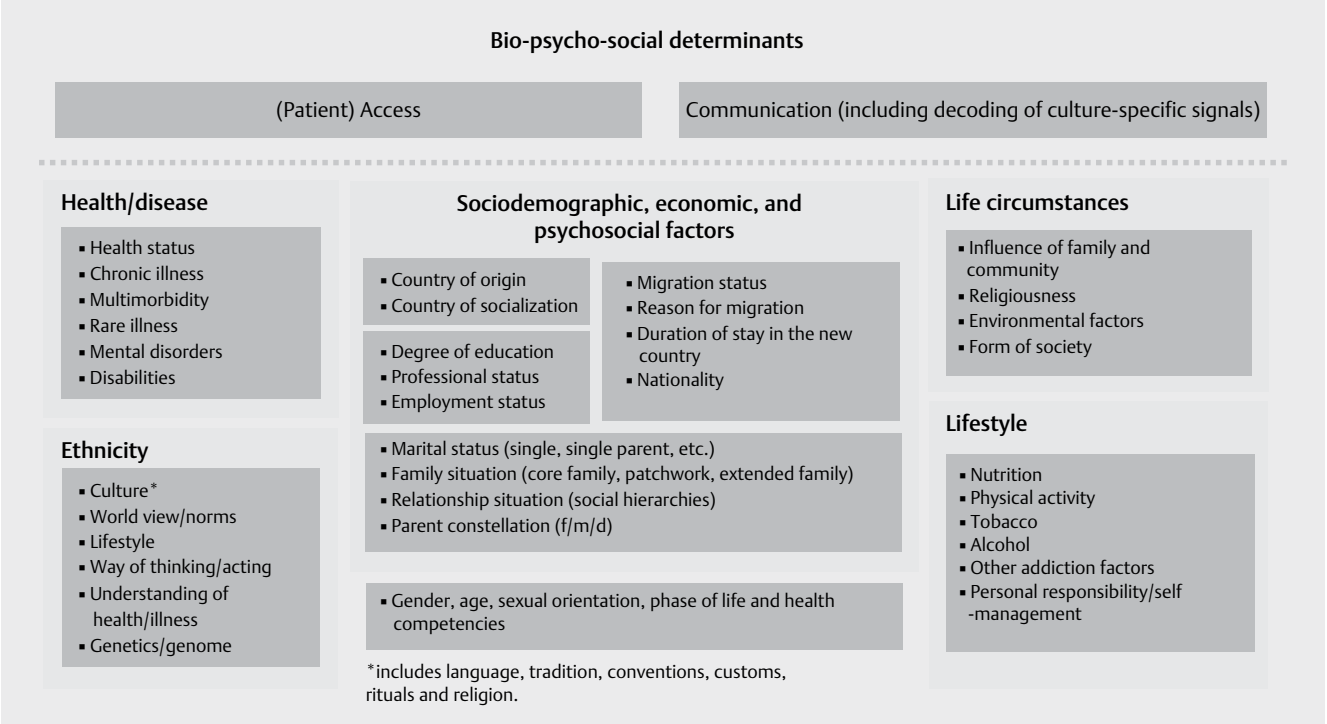
If a language barrier exists and if it is possible, training and treatment in the native language should be provided which match the educational level and lifestyle of the patient.

Intercultural content should be incorporated into the education, training and continuing education of healthcare professionals (doctors, diabetes advisors, diabetes assistants, dieticians, nutritionists, nursing staff, etc.). It is also recommended that bicultural and multilingual personnel will be increasingly trained and promoted in health services. In medical history taking and therapy, it is important to consider bio-psychosocial influences and thus to keep religious attitudes as well as interfamilial and social hierarchies in mind (▶ **Fig. 1**).

Language

Communication during treatment should be in one language (treatment language). If necessary or possible, interpreting should be done by specialized interpreters or language and culture mediators.

Generally, children should not serve as translators. In consideration of the situation, if a professional interpreter is not available, adult relatives can be involved to assist. It is advisable to communicate using clear, simple, short sentences and general terms. If necessary, another language (including colloquial language) can



▶ **Fig. 1** Bio-psychosocial determinants to be considered during patient consultations. (f, female; m, male; d, diverse) Source: © Faize Berger.

Fig. 3 DocCard – Interpreting.

UKD Universitätsklinikum Düsseldorf — HEINRICH HEINE UNIVERSITÄT DÜSSELDORF

fit for DIVERSITY SKILLS

Successful doctor-patient conversations with interpreters - you know how!

Before the consultation :

Inform the interpreter* about:

- ✓ Content, goal and estimated duration of the consultation
- ✓ The need for a translation that is as ***literal*** and ***complete*** as possible
  - ✓ without personal interpretations, even if patient statements seem unpleasant, illogical or inappropriate
  - ✓ with the translation of personal requests
  - ✓ with the translation of comments such as "I wonder if...","You seem to me to give the impression that..."
  - ✓ with the translation of emotional expressions and notions
- ✓ The importance of always translating in the first person
- ✓ The possibility to ask at any time in case of comprehension problems
- ✓ The possibility to make notes on names, numbers, details, if necessary
- ✓ The duty of confidentiality to which the interpreter is also subject

During the consultation:

- ✓ Introduce not only yourself, but also the interpreter and patient to each other by name
- ✓ Inform the patient that the interpreter is also obliged to keep confidentiality
- ✓ Keep ***eye contact*** with the patient even when the interpreter is speaking
- ✓ Always address the patient ***directly***, never talk about him/her in the third person
- ✓ Use more mimic and gestural means. Formulate ***clear***, distinct and complete sentences
- ✓ Ask only one or a few questions at a time, give only a ***little information at once***
- ✓ After translating the patient's answers, ***pause*** in each case to wait for patient questions if necessary
- ✓ Probe the patient if interpreted patient statements do not make sense to you or do not seem to match your questions
- ✓ Respond directly to the patient when he or she seems to understand something in your language
- ✓ Ask the patient to ***summarize*** what she has understood at relevant points (at least at the end of the appointment!)

After the consultation:

- ✓ Ask the interpreter if he or she had the impression that the patient could follow the conversation and understand everything
- ✓ Ask the interpreter for a short feedback on the way you conducted the conversation
- ✓ Give the interpreter brief feedback on her work (including any problematic phases of the discussion)
- ✓ Thank the interpreter for his or her support

A separate DocCard is available for use in a conversation without an interpreter

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Info Film

* refers to patients of all genders

Fig. 2 DocCard – Language barriers.

UKD Universitätsklinikum Düsseldorf — HEINRICH HEINE UNIVERSITÄT DÜSSELDORF

fit for DIVERSITY SKILLS

Successful doctor-patient conversations despite language barriers - you know how!

BEFORE

- ✓ Clarify with the patient in which language you can communicate

LANGUAGE

- ✓ Formulate short and ***simple, but complete sentences***
- ✓ Speak slowly and emphatically, but not too loud
- ✓ Use simple words
- ✓ Name, but then paraphrase technical terms

BODYLANGUAGE

- ✓ Use **more mimic and gestural means**
- ✓ Pay increased attention to a friendly, **positive body language**
- ✓ Pay increased attention to facial expressions, gestures and body language of the patient

UNDERSTAND

- ✓ **Supplement** your statements with drawings if possible
- ✓ Ask the patient to **summarize** what she has understood at relevant points (at least at the end of the appointment!)

A separate DocCard is available if conversation with an interpreter is required

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* refers to patients of all genders

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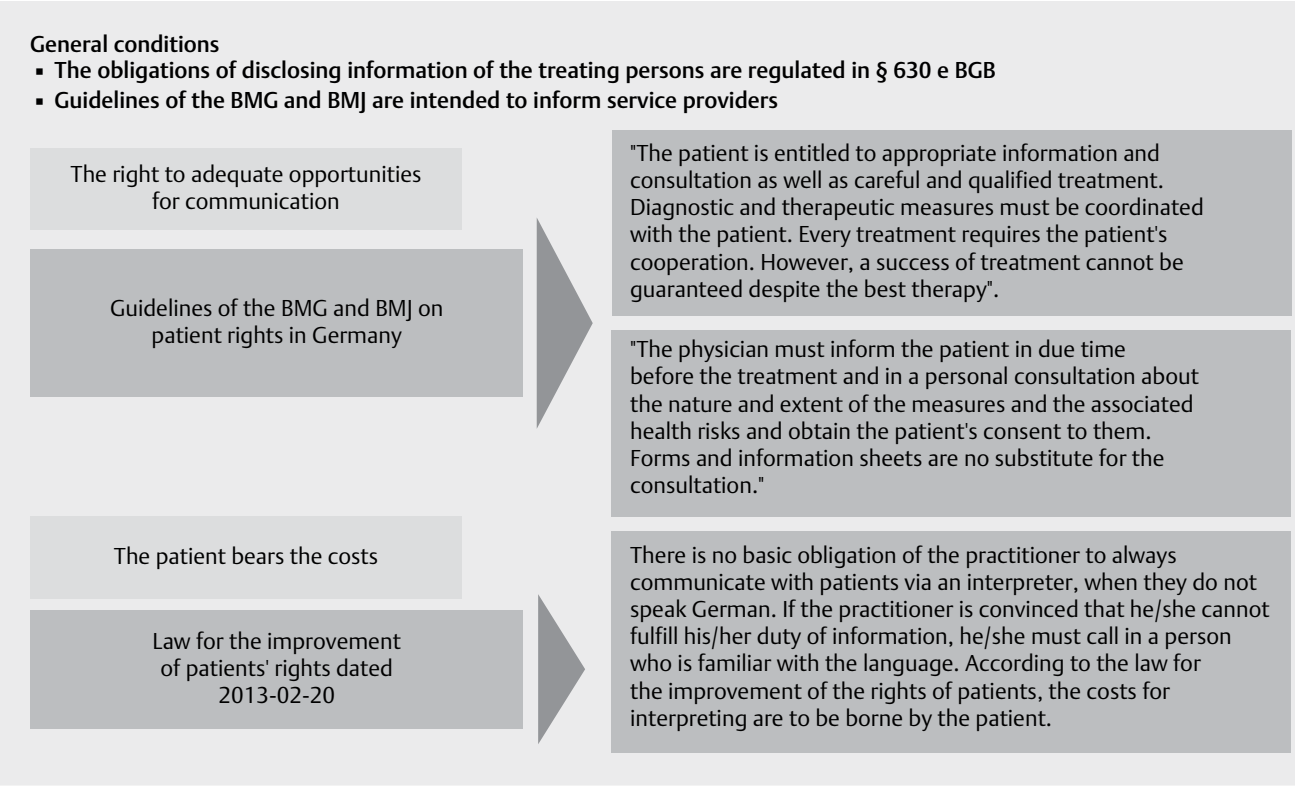


▶ **Fig. 4** General conditions for the education of patients and service providers based on the BMG and BMJ guidelines on patient rights in Germany 2005 [Source for the guidelines: Federal Ministry of Health and Federal Ministry of Justice (Bundesministerium für Gesundheit und Bundesministerium für Justiz) (2007): Patient rights in Germany, Guidelines for Doctors (Patientenrechte in Deutschland, Leitfaden für Ärztinnen/Ärzte). Berlin. https://www.bundesgesundheitsministerium.de/uploads/publications/BMG-G-G407-Patientenrechte-Deutschland.pdf (Dated: 2015–09–20)]] and the Law for the Improvement of Patients' Rights (Gesetz zur Verbesserung der Rechte von Patientinnen und Patienten) [Bundesgesetzblatt Jahrgang 2013 Teil I Nr. 9, p. 277–282]. BMG: Federal Ministry of Health (Bundesministerium für Gesundheit), BMJ: Federal Ministry of Justice (Bundesministerium für Justiz).

be used or medical personnel with appropriate language skills can be involved, taking into account the obligation of confidentiality.

The DocCards shown below are recommended as a practical orientation aid for the procedure in doctor-patient consultations with and without an interpreter (refer to DocCards under DDG working materials http://migration.deutsche-diabetesgesellschaft.de/arbeitsmaterialien/doccards.html) (▶ **Fig. 2** and **3**)

In their guidelines on patients' rights, the Federal Ministry of Health (Bundesministerium für Gesundheit) and the Federal Ministry of Justice (Bundesministerium für Justiz) point out that every patient has the right to adequate opportunities for communication and appropriate information and consultation, as well as to thorough and qualified treatment. However, they do not mention the financing of professional interpreting services (▶ **Fig. 4**). The legal framework shown in ▶ **Fig. 4** is not valid for Austria.

The importance of online translation services is also growing in healthcare. Currently, more than 100 languages can be translated via websites or apps. The use of these tools in healthcare is underresearched and there are many differences in the quality of translation. Studies show a strong variability in the accuracy of the translation of medical content. While the accuracy is highest for Romance languages with 80 %, for Slavic languages about 60 % accuracy. For African and Asian languages, however, it only reaches 40–50 % [49].

For the future, a rapid further development of apps and websites for the medical sector is to be expected. Commonly used online translation services include:

- Google Translator (app or website)
- Bing (app and website)
- MediBabble (medical translation app)
- Canopy Speak Medical Translation (medical translation app)
- CALD Assist (app specifically for health workers)
- Naver Papago Translate (app)
- SayHi Translate (app)

Simultaneous translation equipment also already exists.

Telephone interpreting services enable better doctor-patient communication when patients and doctors speak different languages. Nevertheless, the interpreter may need to see the patient physically in order to better advise the doctor. To this end, interpretation services using videoconferencing should be further developed [50].

Nutrition

Different cultures and regions sometimes have very individual eating habits.

Food culture is shaped by geographical, historical, sociological, economic and psychological characteristics of a society and is shared by the corresponding members of a particular community. Culture is a fundamental determinant of "what we eat" [51].

Migrants often have different dietary habits than natives. They sometimes prefer other foods, often eat more carbohydrates, have different meal concepts, a different understanding of portions, and different food preparation forms and food combinations. Their nutritional concepts are usually based on their own traditional cuisine, personal habits, and they also adopt the eating habits of the local population, often resulting in a new "mixed cuisine" [52], [53]. It is not uncommon for special foods to be procured from the home countries. Migrants from some cultures have little use for the weight information in local recipes when cooking.

People have a highly variable postprandial glucose response to identical foods. Individualized culturally-sensitive counseling improves compliance [54] and is well-accepted as a weight loss intervention measure [55].

In this context, fasting during Ramadan – religiously-influenced food selection and fasting regulations (see below), pregnancy and shift work play a particular role.

In everyday practice, knowledge of the main carbohydrate sources and in what form and when the carbohydrates are eaten is indispensable. The following practice tool for the nutritional habits (▶ **Tab. 1**) of migrants is intended to provide initial information and assistance. A pragmatic regional breakdown with information on common cuisine forms the basis. The main sources of carbohydrates and other regional characteristics are presented in addition to the type (warm/cold) and number of meals.

Cuisines are quite diverse around the world and there is also a great deal of regional diversity. Nevertheless, it should be noted that many drinks have now made their way into many food cultures around the world, such as soft drinks, energy drinks, drinks sweetened with sweeteners, and some beer types.

Training and counseling material

Both culturally-sensitive individual training courses and target group-adapted group counseling enable effective communication of information about diabetes mellitus, its secondary and concomitant diseases, perception of hypo- and hyperglycemia and therapy.

Therapies tailored to the cultural needs of study participants in randomized controlled trials show a reduction in HbA1c and body fat values [56].

Training materials with culturally-sensitive examples should be available at least in the respective native languages and ideally be bilingual.

The use of pictograms, illustrations, symbols, demonstration utensils, especially pen needles, test strips, applicators, blood glucose devices, etc. is recommended not only to reach the illiterate people with diabetes, but also to provide effective training. It is important for the portion sizes to be accurate when creating images of food and the like. For illiterates, the use of blood glucose devices with a large display or speaking meters is recommended (also available in foreign languages). At present, there is hardly any training material available on diabetes technology in the context of migration. The instructions for use of the devices cannot replace the need for training materials.

A selection of foreign language information and training materials has been compiled on the homepage of the DDG's Working Group on Diabetes and Migrants. In addition, the DDG's Working Group on Diabetes and Migrants has actively brought together important institutions in order to provide professional, culturally-sensitive working materials for nutritional counseling in diabetes mellitus.

Communication strategies and training should be tailored to a vulnerable group and/or gender and adapted to all known barriers. Family and friends play an important role in this. For example, it is conceivable to involve family members in cooking or exercise courses [57]. In Sweden, a culturally-adapted diabetes education model has been developed that includes participants' individual beliefs about health and disease, their knowledge of diabetes and their experiences with self-care [58]. Indeed, lifestyle interventions among migrant groups and ethnic minorities appear to be only moderately effective in lowering the HbA1c value [57]. A recent systematic review with meta-analysis also finds that lifestyle interventions with peer support have positive effects on clinical outcomes such as the HbA1c value, as well as on the knowledge and practices of diabetes self-management [59].

Pregnancy – Gestational Diabetes Mellitus (GDM)

GDM occurs with above-average frequency among women with a migration background [60], but due to the great heterogeneity, migrant women, or women with a migration background in general do not represent a specific uniform risk group for GDM. The extent of the influence depends on the prevalence of the individual risk factors, the respective ethnicity, and the specific migration situation [61].

A retrospective analysis conducted in Austria clearly shows the diversity of the individual migrant populations in relation to GDM. Between 2013 and 2015, data collected from 3293 pregnant women at a university hospital were evaluated taking into account the country of birth. The GDM risk for Turkish immigrant women was approximately twice as high as the risk of pregnant women born in Austria. The risk was about 1.5 times higher among women from Romania, Hungary, and Macedonia than among the native population [60].

Risk factors favoring the development of GDM were more frequently observed among migrant women from Turkey, the Near and Middle East and Africa than among women born in Austria or migrant women from other European countries. These include the genetically-higher risk of developing type 2 diabetes over the course of life, overweight/obesity, higher parity and higher GDM risk. The situation is similar with the probability of developing manifest type 2 diabetes mellitus later in life.

GDM is associated with an increased risk of premature birth and caesarean section, while migrants have a higher risk of all complications considered, regardless of GDM. However, the increase in all

these risks, including macrosomia or large for gestational age (LGA), remains marginal when women with GDM receive more attention from the healthcare system and equivalent treatment [62].

Women with low socio-economic status and migrant backgrounds often find it difficult to understand the requirements of GDM self-management. In order to improve adherence to treatment plans, they need educational and support services that are culturally appropriate and aimed at lower levels of literacy [63].

Obesity/excess weight

In certain migrant populations – especially among women from the Middle East, Turkey, and North and South Africa – numerous studies have found a markedly high prevalence of excess weight and obesity. For pregnant women from Turkey and North Africa, a French birth cohort study of 18 000 women also showed a significantly higher risk of excess weight/obesity and GDM. Women from Eastern Europe and Asia, on the other hand, have a lower weight risk but still a higher risk of developing GDM than pregnant women without a migration background [64].

Pre-conception care of migrant women already reduces the risk of complications.

Nutrition

Nutrition, coupled with cultural and traditional particularities, is of increased importance during pregnancy. For example, it is commonly observed that pregnant women think that they should "eat for two". The idea of giving in to pregnancy cravings is also often consciously supported.

It is therefore absolutely essential to provide culturally-sensitive training, develop an individual nutrition plan and closely monitor its implementation and adaptation, especially with migrant women who come from risk regions and as part of planned or existing pregnancy. The practice tool on nutrition (▶ **Tab. 1**) can be used for orientation and as a preliminary aid regarding the main carbohydrate sources in the respective native cuisine.

Vitamin D deficiency

Direct sunlight is very high in the country of origin for people from Africa, the Near and Middle East and the Indo-Asian region and their vitamin D status is usually insufficient after migration to Europe. The results of studies on the effect of vitamin D deficiency on GDM are not clear [65]. In general, however, a vitamin D deficiency is an avoidable health risk.

Therefore, especially in pregnant migrant women from the above-mentioned regions, the vitamin D status should be assessed and risk minimization should be considered, if necessary by substitution.

Breastfeeding

Breastfeeding the newborn for at least 3 months reduces the mother's risk of diabetes mellitus [66]. The World Health Organization (WHO) therefore recommends full breastfeeding for at least 6 months. "Initial analyses of the breastfeeding behavior surveyed in KiGGS show that children with a migration background are breastfed more frequently and also longer than those without a migration background. 88.1 % of Russian-German children and 79.3 % of children of Turkish origin were breastfed more frequently compared to children without a migration background (76.2 %). The fact that only three-quarters of the children grouped under "other" migrants received breast milk is an impressive indication of the heterogeneity within the migrant population" [67].

Migrant women should be motivated to breastfeed for at least 6 months, especially if they are overweight/obese.

Treatment with antibiotics

Antibiotic therapy during pregnancy leads to disrupted development of the microbiome in the newborn's intestine [68] in the postnatal period. Especially among the women who have fled to Germany since 2015, it can be assumed that they may have been exposed to antibiotic therapy more frequently than native women with and without a migration background. On the one hand, the group described above is more likely to carry multi-resistant germs, which could be an indicator for antibiotic use, and on the other hand, there are also culturally-determined convictions regarding antibiotic therapy. For example, therapy with antibiotics is almost a cultural norm in the Iraqi population, and patients consider the prescription of antibiotics as an adequate standard therapy.

Therapy adherence and antenatal care for migrant women

As with some other subgroups, migrant women are particularly at risk for GDM due to the often low level of education, communication deficits, low health skills, and high unemployment. Without professional help, they find it difficult to find their way around within the healthcare system. They often know neither the care processes and the importance of preparing for pregnancy, nor the prenatal and postnatal examinations that are a regular part of medical care and preventative care in Germany. Doctors should inform their patients with a migration background about preventative care options at an early stage. Physicians in general practice, on the one hand, report that younger migrant women who are familiar with the care structures regularly attend pre- and postnatal check-ups and show at least similar, if not significantly higher, compliance compared to native women of their age. On the other hand, there are women who come to a delivery center or hospital with labor pains and the medical team can hardly obtain information about the course of their pregnancy to date due to communication problems. The team may also encounter these pregnant women for the first time and find that they have received little or no medical advice or support during their pregnancy. In connection with diabetes, pregnancy and migration, other factors such as health literacy, understanding of illness/health, influence and role of family, traditions, customs and rituals must also be taken into account. In the group of women who migrate because they are forced to flee and who have no proof of identity, other aspects such as traumatization, violence (including rape) and a higher number of abortions can be added in this context [69].

It would be desirable for the treating physicians to have a basic understanding of how pregnancy and maternity are understood in the respective cultures as well as basic psychosocial knowledge for dealing with trauma victims.

▶ **Tab. 1** Practice tool for nutrition. This table does not replace the official food-based dietary guidelines.

Geograhic origin	Meals c = cold w = warm	Time of main meal	Main carbohydrate sources	Beverages	Particularities
Mediterranean cuisine					
E.g. Turkey, Mediterranean coast, Greece, Spain, France, Italy, Israel[1, 2]	c-w-w	Evening (relatively late)	Wheat bread (flatbread/ sourdough bread), pasta, rice, bulgur, polenta (Italy), potatoes	Tea (drunken with or without sugar), coffee + milk + sugar, mocha + sugar, wine (from midday), alcoholic with meze/tapas	Ayran = yoghurt drink, mainly yoghurt sauces (TR), lots of vegetables, lots of fruit (fresh and dried), nuts, pastry specialties (pizza, croissant, börek, pita etc.), fish * , Helva (sweetened sesame paste), religiously kosher and halal preparations Fats: mostly olive oil
Balkan cuisine (Southeast Europe)					
E.g. Bulgaria, Serbia, Kosovo, Montenegro, Albania, Bosnia-Herzegovina, Slovenia, Croatia, Romania, Hungary	c-w-w	Evening	Wheat bread, potatoes, rice, pastry specialties (filled dough pockets, burek)	Tea (drunken with or without sugar), coffee	Similar to the Mediterranean cuisine, with a high fat content, lots of meat * and sauces, sweet yeast bread (Povitica, Kolachki), polenta, dumplings (Romania, Hungary), pudding for dessert
Eastern European Cuisine					
E.g. Russia, Poland, Baltic States[6]	c-w-w	Lunch and dinner	Rye bread, buckwheat (Kasha, blinies), dumplings, rice, filled dough pockets, potatoes, wheat bread	Tea (drunken with sugar, honey, milk or jam) wine, vodka, brandy	Fatty, semolina/oatmeal porridge prepared for breakfast with milk, a lot of stew with meat broth, a lot of sauces, soups with potatoes as the main ingredient, desserts prepared with condensed milk
Oriental cuisine					
E.g. Iran, Afghanistan, Syria, Arab Mediterranean countries, Southeast Anatolia[1, 5]	c-w-w	Evening (relatively late)	Rice, wheat bread, legumes (especially chickpeas)	Tea (black, green and apple tea) and coffee (usually sweetened with lots of sugar or honey)	Fruit: Pomegranate (fruit and as syrup), dates, figs, pastry specialties: hearty (like burek) and sweet (like baklava), dessert: Knefeh (wheat dough with cheese, rose water and sugar syrup), baklava, Halawa (sweetened sesame paste), many herbs, no pork, rice dishes sometimes with vermicelli, tahin (sesame paste), hummus (chickpea paste), nuts. Fats and oils: olive oil, butter, sheep's tail fat (delicacy)
North African Cuisine					
E.g. Morocco/ Maghreb, Mauritania[3]	w-w-w	Evening	Wheat bread, rice, potatoes (in tagine), pulses (chickpeas/ humus), couscous, shombi (milk, rice or corn in the evening), baghrir (semolina with honey or sugar for breakfast), makroudh (semolina with date filling)	Juices, mint tea + sugar	Harira soup (with rice or vermicelli served with dates), Shombi (milk, rice or corn/evening), Tagin with caramelized fruits (Tagine Lahlou), fruit, meat *, fish * Fats and oils: olive oil, argan oil and butter
African cuisine (Excluding North Africa)					
Sub-Saharan African countries	w-w-w	Evening	Yams (starch supplier), plantains, sweet potatoes, potatoes, cassava, millet	Millet beer, Mageu (fermented corn porridge), beer, raw sugar schnapps, coffee liqueur, but also wine	Fufu (a tough porridge made from various ingredients such as plantains, sweet potatoes, corn, manioc and/or yams), curry with meat, fruits, fish * , lots of meat * , Koeksister (fried pastry dessert which is submerged in a special syrup and dried), Maroelas (the sour tasting fruits of the Marula tree)
East Asian Cuisine					
E.g. Philippines, Indonesia, Japan, China[4,7]	w-w-w	Lunch and dinner	Rice (incl. sushi), rice noodles (Thai), egg noodles (Indonesia), wheat, wheat noodles (Udon) also made of buckwheat, mung beans or sweet potatoes	Tea, rice wine	Sweet and sour sauces, many soybean products, few dairy products in China, Japan and South Korea, short grain rice at every meal, a lot of (also raw) fish * , briefly cooked fresh vegetables, soups

▶ **Tab. 1** Continued.

Geograhic origin	Meals c = cold w = warm	Time of main meal	Main carbohydrate sources	Beverages	Particularities
South Asian Cuisine					
E.g. India, Sri Lanka, Pakistan[5]	w-w-w	Lunch	Rice, wheat bread (naan, chapati), filled dough pockets (roti)	(Mango) lassi (thick and sweet yoghurt drink), tea with milk and honey/ sugar (chai)	Spicy food, strong spices, coconut milk, lots of fried and breaded foods, yoghurt sauces, legumes (including dhal), tea + milk + sugar, pickled fruits (rayta, pachadi), milk-based desserts
South American cuisine					
E.g. Brazil, Venezuela, Argentina, Peru, Caribbean[5]	c-w-w	Evening	Amaranth, quinoa, corn, rice, wheat, baked or fried empanadas, tapioca starch (obtained from cassava/massava flour), black beans, potatoes	Cachaca (sugar cane brandy), coconut juice, tequila, rum, wine, mate tea	Lots of fruit (e. g. camu camu, guavas, mango, papaya, passion fruit), soups, cuscuz (steamed food made from corn flour, the sweet variety of coconut couscous, in Brazil), often very spicy. Tacos (made from corn flour are very popular in Mexico), pulses (especially beans), regionally heavy on meat *.

*Fish and meat are only considered if they represent an exceptional part of the diet in the region. **Sources:** [1] J. Boucher, Mediterranean Eating Pattern, Spectrum Diabetes Journals 2017, S.: 1, https://doi.org/10.2337/ds16–0074; [2] K. Gedrich, U. Ottersdorf, Ernährung und Raum: Regionale und ethnische Ernährungsweisen in Deutschland, S.:104. Bundesforschungsanstalt für Ernährung, Karlsruhe, 2002; [3] F. Heidenhof. https://www.bzfe.de/inhalt/hochkultur-bringt-esskultur-essen-in-nordafrika-und-im-nahen-osten-4808.html; [4] F. Deng, A. Zhang, C. Chan, doi:10.3389/fendo.2013.00 108; [5] N. Mora, S. H. Golden, Understanding Cultural influences on Dietary Habits in Asian, Middle Eastern, and Latino Patients with Type 2 Diabetes: A Review of current Literature and Future Directions. Curr Diab Rep (2017) 17: 126/https://doi.org/10.1007/s11%20 892–017–0952–6; [6] Kittler, Sucher, Nelms. Food and Culture 7e, 2017, S 184; 7 Kittler, Sucher, Nelms. Food and Culture, 7e, 2017, S. 305, S. 326.

Prevention

Diabetes mellitus is one of the ten most common causes of death according to the latest WHO ranking. The number of deaths due to diabetes mellitus has increased by 70 % in 20 years – a very serious situation [19].

Especially people with a migration background are less likely to make use of preventive examinations and preventive measures. In the case of cholesterol and blood glucose determinations, significantly more than half of the persons aged 15 years and above (regardless of migration status) (60.7 and 61.4 % respectively) had these examinations carried out in the year prior to the survey. A small proportion of this age group (8.8 and 8.1 % respectively) has never made use of them. As with blood pressure, measurements for cholesterol and blood glucose were performed more frequently in women and more frequently with increasing age [70].

One of the most important aspects is the lack or non-existent level of knowledge to adopt preventive and therapeutic measures.

In a project in Vienna, Turkish migrants in general medical practices were interviewed in their mother tongue, on the one hand about the prevalence of obesity and diabetes or diabetes risk, and on the other hand about health literacy, especially knowledge of risk factors. Compared to a (smaller) group of Austrians, these 115 men and 327 women were older and had a higher BMI. About 11 % already had diabetes mellitus; two-thirds had an increased to very high risk of developing diabetes mellitus within the next 5 years. Women and the elderly were more affected. Knowledge of risk factors was poorer among migrants than among native Austrians.

This study also found that more than a third of respondents were overweight and more than half were obese. Female respondents in particular were more often obese than male respondents and, in comparison, more often obese than migrant women of other origins [70].

The obesity epidemic has also become a serious public health problem with an upward trend. The prevalence of obesity worldwide has more than doubled in the last 30 years and has reached epidemic proportions [71].

Obesity plays a causal role in three of the four most common non-communicable diseases [72]. More than half of adult Austrians are overweight or obese. Children and adolescents are also affected by the obesity epidemic.

Prevention in childhood

According to WHO estimates, 22 million children under the age of 5 years overweight worldwide [73].

The first 1000 days of a child's life, from conception to about 2 years of age, are a critical period for early prevention of obesity. During this time, nutrition is crucial. Often referred to as "metabolic or developmental programming," a nutrient imbalance in infant and maternal diets can have long-term effects on health later in life [74].

Sixty percent of children who were overweight before puberty carry an increased risk of remaining overweight or obese in adulthood [75].

Children and adolescents with overweight or obesity also suffer from psychological comorbidities at an above-average rate, which can also result in poorer academic performance and reduced self-esteem [76].

In the case of children with a migrant background, the data is even more concerning. In 2012, Segna and colleagues showed among 25000 children (2–16 years) in Vienna how the child's mother tongue related to weight status. Of these children, 46 %

had a migrant background. In particular, children with Turkish as a native language, but also children with other linguistic backgrounds, were significantly more often overweight and obese than children with German as a native language [77].

Something similar was also shown at 12 Bielefeld schools. There, data from children aged 6–7 years were evaluated on the basis of measurements of weight and height, as well as calculation of BMI according to the IOTF criteria. This study also described that children with a migration background were more frequently overweight and obese than children of German origin [78].

Another study showed that children with a migrant background are less physically active and more likely to be overweight [79].

The Child and Adolescent Health Survey (KiGGS) evaluated indicators and determinants of the health status of 0- to 17-year-old children in Germany. The authors derived concrete recommendations for priority health policy action were also derived and published from these findings. Thus, the KiGGS data contribute to "evidence-based prevention" [80].

Valuable data can be found in the WHO – European Childhood Obesity Surveillance Initiative, which was conducted in 23 countries in children between 6–9 years of age [81].

The planning and implementation of health promotion and prevention measures should be based on valid and up-to-date population-based data. As the scientific evidence shows, this should already start at preschool age.

Systemic prevention and individual prevention

Prevention approaches differ in terms of the temporal perspective in the course of disease, comparing primary (before the onset of the disease, e. g. weight loss to prevent diabetes), secondary prevention (in the early stages of a disease, for example to avoid diabetes complications) and tertiary prevention (in the case of a disease manifestation, e. g. to prevent newly-occurring complications).

As the German Health Report Diabetes 2022 shows, both systemic prevention measures and individual behavioral prevention are important for the prevention of type 2 diabetes. Systemic prevention aims at the living environment of the population in order to positively influence behavior through health-promoting changes.

Such public health measures can be complex: this is why various measures can be considered solely to promote healthy eating habits, such as advertising restrictions, food labelling, product reformulations, the prominent placement of healthy foods in certain settings such as canteens, subsidies and taxes, or bans on the distribution of certain foods in specific settings such as schools [82].

Individual behavioral prevention, on the other hand, aims to influence the behavior of individual risk groups. Studies have shown that people who are at an increased risk for type 2 diabetes benefit from early detection and possible lifestyle change interventions [83].

Risk screening and risk scores

The DDG propagates two diabetes risk calculators to estimate the risk of developing type 2 diabetes [84]. First, the DIfE – GERMAN DIABETES RISK TEST (DEUTSCHER DIABETESRISIKO-TEST® – DRT) [85], which is provided as a culturally-adapted version by the Robert Koch Institute, and second, the FIND-RISK [86].

Risk scores can support the exact determination of the absolute risk of disease of individuals – a "precision prognostic". Reducing the risk of diabetes is a declared goal of the Prevention Act [87]. These prevention measures are independent of migration status and apply to everyone.

Lifestyle changes: the sooner, the better

The effects of a permanent lifestyle change are now well documented by various complex intervention studies. With increased physical exercise and reduced calorie intake aiming at moderate weight loss, the incidence rate and the course of an existing type 2 diabetes can be favorably influenced. Participants in the American Diabetes Prevention Program (DPP) study were motivated to reduce weight by 7 % and to engage in physical activity of at least 150 min/week. After a median observation period of 2.8 years, they recorded the most significant weight loss (approximately -5.6 kg) and a 58 % reduction in diabetes risk compared to metformin treatment and the control group.

The lasting effect of lifestyle changes has been shown by recent data from a follow-up study of the same participants, which was conducted 10 years after the start of the study. Even though the participants of the "lifestyle change" measure had gained some body weight again, the beneficial influence on the risk of new disease was maintained (about 34 % risk reduction). According to the data, it is particularly worthwhile to exercise more, eat healthy and control weight at a young age [88].

There is evidence that the first 5 years after migration may provide an opportunity to take targeted action to maintain healthy eating habits [89].

Proven principles of lifestyle change

At the same time, some studies also provide information about promising lifestyle changes.

- Reduced calorie intake has a beneficial effect on body weight, blood pressure, insulin sensitivity and fasting blood glucose after 24 months, regardless of the composition of the food [90].
- A reduction or modification of fat consumption is accompanied by an initially-small reduction in cardiovascular risk, which becomes increasingly clear with increasing study duration [91].
- With the help of simple "nutritional patterns", it is possible to keep the weight stable. They include a high consumption of fiber, fresh fruit, vegetables, as well as restricting meat and meat products, butter, and high-fat cheeses [92].
- For the goal of weight loss, increased physical activity should be combined with reducing calories. Experts recommend both consuming fewer calories and increasing physical activity to prevent muscle loss. Exercise helps to stabilize achieved weight loss success. An additional 5 hours of exercise per week is recommended, which corresponds to an additional consumption of about 2500 calories per week. Exercising moderately on a regular basis is most effective: the decisive factor is the duration, not the intensity.

General

Fasting is considered the voluntary complete or partial abstention from food, beverages and luxury food over a certain period of time; this is in contrast to starving where there is a lack of food. There are different reasons for fasting: health, mental, religious or physical, among others.

Fasting type and duration can vary greatly depending on the reason for fasting.

In the following, the fasting month of Ramadan is discussed in more detail.

Ramadan – one month of fasting

Approximately 1.6 billion people around the world live with Islamic religious beliefs. Ramadan is the month of fasting for Muslims and the ninth month of the Islamic lunar calendar [93]. Fasting during Ramadan lasts one month. During the fasting period, from sunrise (Sahur = meal at sunrise or beginning of fasting) to sunset (Iftar = meal after sunset or breaking of fasting), no liquid or food may be consumed. Due to the lunar calendar, the fasting period is shifted forward by about 10 to 11 days every year. People with chronic diseases (including pregnant women and nursing mothers) are not obliged to fast. Many devout Muslims with chronic diseases insist nevertheless on fasting but this should only take place under medical supervision [94]. According to the EPIDIAR study, about 43 % of patients with type 1 diabetes and about 79 % with type 2 diabetes fasted for at least 15 days during Ramadan [95]. A retrospective, 13-country study reported that 64 % of patients fasted daily during Ramadan and 94 % fasted for at least 15 days during that period [96]. Fasting presents a special challenge for people with diabetes and their therapists. In general, an adjustment or modification of the existing therapy according to the current guideline recommendations of the DDG or ÖDG should be referred to before the start of the fasting period. If a person with diabetes wants to fast, the intake and dosages as well as the side effects (especially minimizing the risk of hypoglycemia) of the medication have to be adapted to the new eating habits. Since the main meal is at sunset, the day-night rhythm is reversed. In accordance with this rhythm, some medications, especially sulfonylureas and insulin therapy, need to be changed or their dosage adapted - the prevention of hypoglycemia is the main priority. Further complications during fasting are hyperglycemia, dehydration, increased risk of thrombosis and ketoacidosis [97].

Since insulin injection is used to treat diabetes mellitus and not to replace or support nutrition, i. e. eating and drinking, patients can perform their insulin injections during fasting as prescribed by their doctors.

In 2021, the International Diabetes Federation (IDF) and Diabetes and Ramadan Alliance (DAR) published a practice recommendation for patients with diabetes who want to fast during Ramadan [94]. Patients are assigned to different risk groups according to the assessment of their risk of developing one or more complications (as mentioned above) during fasting (▶ **Fig. 5**) [93].

In the DAR Global survey, only 60.2 % of participants had access to diabetes training, with only 50.7 % (141/278) of participants under the age of 18 years receiving training, compared to 63.6 % (490/771) of participants aged ≥ 18 years.

The risks associated with fasting are not the same for all people – adolescents and adults – with type 1 diabetes.

Fasting during Ramadan is generally associated with a high risk of hypoglycemia and hyperglycemia for people with type 1 diabetes. With well-structured pre-Ramadan education programs, the risks associated with fasting can be reduced, and eligible individuals can be allowed to fast under strict supervision and after adjusting the insulin doses accordingly. Treatment adjustments should be made individually. The following factors should be taken into account: pre-Ramadan attitude towards diabetes, previous experience with Ramadan, availability of aids, level of education and motivation for self-treatment. Different demographic characteristics affecting the duration of fasting, access to insulin and glucose monitoring must be taken into account in any risk assessment for safety fasting. Insulin analogs are preferable to conventional insulin regimens during fasting. Frequent Standrad Blood Glucose Monitoring (SMBG) was previously essential and is now supported and partially replaced by Constant Glucose Monitoring/Fasting Glucose Monitoring (CGM/FGM) or sensor-based pump therapy. Modern insulin technology seems to be very promising for enabling safe fasting [93].

Studies also recommend that healthcare professionals work together for shared decision-making to address cultural differences and patients' particular cultural needs. A systematic review shows that patients and health professionals should be informed about fasting during Ramadan and that knowledge should be spread in the world's major regional languages in order to disseminate the information to educationally-disadvantaged communities [97].

Therapy dosage suggestions during the fasting period of Ramadan

The specified order of the substance groups does not correspond to the prioritization of the use according to the current guideline.

Oral antidiabetic therapy [93] (Table 2)

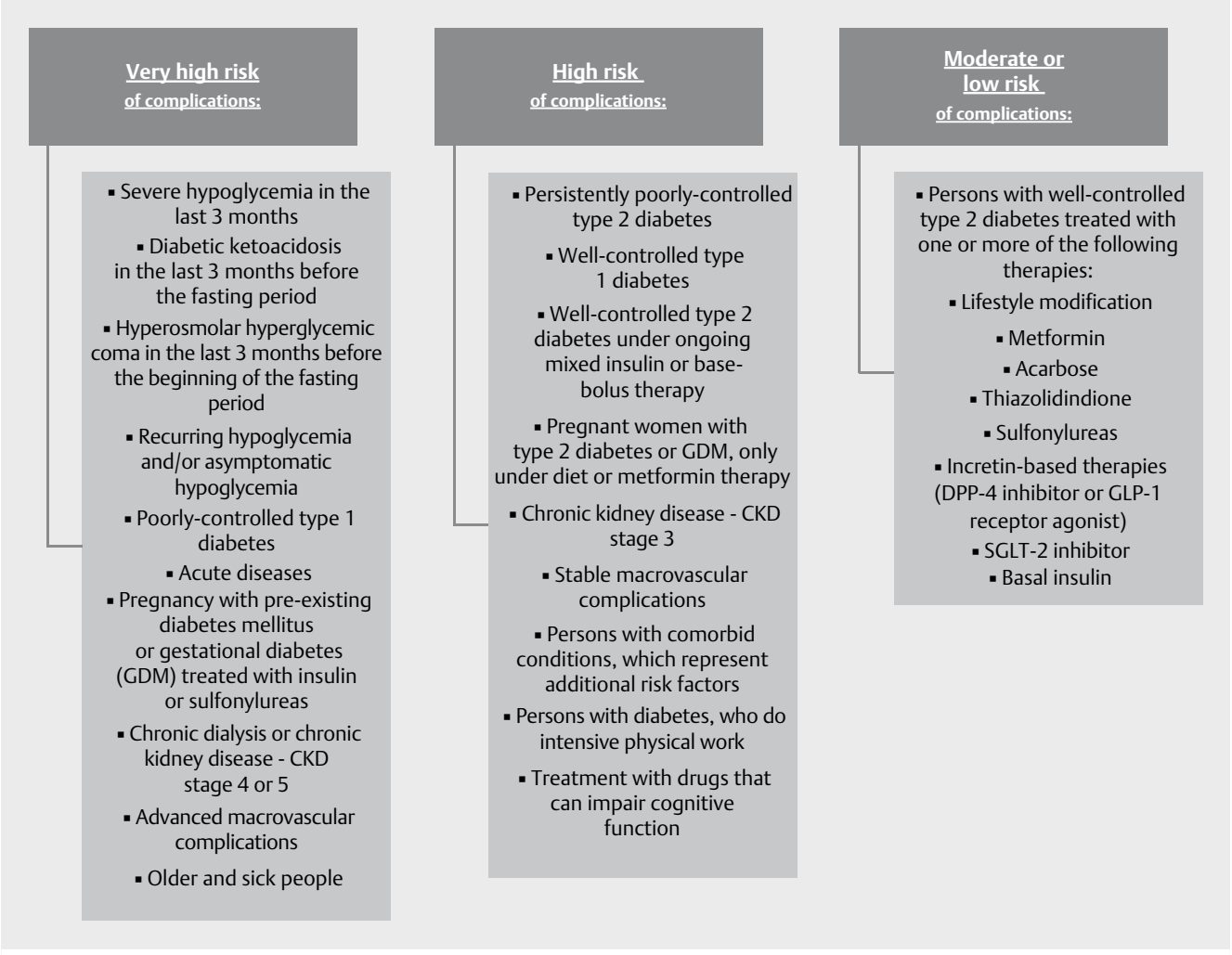
There is evidence that therapy differs depending on cultural affiliation. For example, a study in the UK showed that therapy escalation over the course of treatment for diabetes mellitus occurs much less frequently in people from Africa and South Asia than in the European population [37]. The reasons for this have not yet been sufficiently investigated, but a multifactorial justification can be assumed. An important factor seems to be the lack of permanent medical care.

Metformin

The dosage can remain unchanged, and will be taken at Sahur and Iftar. If it is taken twice a day (e. g. 1000 mg of metformin), the dosage should not be changed. In case of a triple dose (e. g. 500 mg of metformin) it is recommended to take 500 mg of metformin at Sahur and 1000 mg at Iftar.

Acarbose

It is recommended to be taken with meals without changing the dosage.



▶ **Fig. 5** Risk assessment regarding the occurrence of one and/or more complications during fasting. Source: Şat S, Aydinkoc-Tuzcu K, Berger F et al. Diabetes and Migration (Update 2019). Wien Klin Wochenschr 2019; 131 (Suppl 1): 229–235.

Sulfonylureas (SH)

The basic recommendation is to change to another substance class with a lower risk of hypoglycemia in accordance with the currently-valid guidelines of the DDG or ÖDG.

If the SH therapy is nevertheless to be continued, a change to the newer generations of sulfonylureas (e. g. gliclazide, glimepiride) is recommended. In case of one single dose, a dose reduction of 25 % is recommended, as well as timing the dose to breaking the fast (Iftar). If two doses are taken, it is recommended to reduce the morning dose as well (or skip it if no meal is taken at Sahur) and take the second dose when breaking the fast without changing the dose (▶ **Tab. 2**).

Glitazones

The dose is recommended without reduction at Iftar or Sahur.

Dipeptidyl peptidase-4 inhibitor (DPP-4 inhibitor)

Recent data show that DPP-4 inhibitors (especially vildagliptin, sitagliptin) are a safe therapeutic alternative during fasting. The HbA1c value did not differ significantly from SH [98]. The use of DPP-4 inhibitors resulted in a lower risk of mild, symptomatic, and severe hypoglycemia compared to SH [98, 99]. The dose of a DPP-4 inhibitor is not changed and can be taken at Iftar [93].

Glucagon-like peptide-1 receptor agonist (GLP1-RA)

In the Treat-for-Ramadan study, Liraglutide showed a lower risk of hypoglycemia than SH, as well as improvements in HbA1c and weight loss [94]. In addition, the LIRA-Ramadan study demonstrated the efficacy and safety of liraglutide over a 52-week observation period including fasting [94]. Liraglutide resulted in an improvement in fasting glucose levels, sustained weight loss and a reduction in HbA1c [99].

Sodium-dependent glucose transporter-2 inhibitor (SGLT-2 inhibitor)

No dose reduction is recommended for this, the dose can be taken at Iftar. It is important to drink enough liquids after breaking the fast (Iftar) up to Sahur. Taking SGLT2-inhibitors is possible for well-

▶ **Tab. 2** Therapy dosage suggestions during the fasting period of Ramadan for oral antidiabetic therapy.

Medication [38]	**Adjustments**		**Particularities**
	Dose adjustment	**Time of administration**	
Metformin	Yes	At Iftar[1] and Sahur[2]	Skip lunchtime dose, For 2 × 1000 mg: maintain dose at Iftar and Sahur, For 3 × 500 mg: at Iftar 1000 mg and Sahur 500 mg
Acarbose	None	At Iftar and Sahur	
Sulfonylurea	Yes	Morning dose at Iftar, evening dose at Sahur	Preferably switch SH therapy to another substance group with a low risk of hypoglycemia. If SH therapy is further prescribed, then preferably glimepiride or gliclazide; avoid glibenclamide. For a single administration: take at Iftar, 25 % dose reduction with good control, if necessary. If administered twice: reduce morning dose at Sahur by 25 % if necessary
Glitazones	None	At Iftar or Sahur	
DPP-4 inhibitors	None	At Iftar	
GLP1 agonists	None	At Iftar or Sahur	
SGLT2-inhibitors	None	At Iftar	Ensure that enough liquid is drunk after breaking the fast (Iftar) until Sahur! Caution with insulin deficiency: danger of euglycemic diabetic ketoacidosis [38].

[1] Iftar: Breaking the fast at sunset.; [2] Sahur: Start of fasting at sunrise.

adjusted diabetes patients with stable metabolism, good kidney function and who do not have an increased risk of dehydration [100].

In principle, the risk of hypoglycemia is low and the weight reduction caused by renal glucosuria is beneficial. However, given the risk of euglycemic diabetic ketoacidosis, caution is advised in cases of insulin deficiency [101]. Ketone measurements are required for all patients who decide to fast and are on SGLT2-inhibitor therapy [102].

Combination preparations of different substance classes

The hypoglycemic effects and corresponding dose recommendation or adaptations of the respective substance groups must be taken into account, as already mentioned above (▶ **Tab. 3**).

Insulin therapy during fasting

BOT – basal insulin-supported oral therapy

It is recommended to reduce the single basal insulin daily dose by 15 to 30 % and to slowly adjust the dose during the fasting period according to the glucose metabolism. Double administration of basal insulin should be distributed as follows: the usual morning dose is administered at Iftar (sunset) and the evening dosage at a 50 % reduction should be administered at Sahur (sunrise) [93, 102].

Rapid or short-acting prandial/bolus insulin

The usual dosage is to be administered according to the carbohydrate source at Iftar. The administration of insulin at midday should be omitted. At Sahur, an initial dose reduction of 25 to 50 % is recommended and the dosage should be adjusted as needed. Functional insulin therapy (FIT) can be derived from the above recommended dose adjustment of basal and prandial insulins.

Mixed insulins

For single administration: administer usual dosage at Iftar. For double administration: usual morning dosage at Iftar, reduce usual evening dosage by 25–50 % and administer at Sahur. In case of three administrations: skip midday dose, otherwise administer as recommended for two administrations and gradually adjust the dose. A dose titration (if necessary, according to a prescribed plan) should be performed every three days according to the glucose value. Close monitoring or consultation with the doctor in charge or the diabetes team is recommended.

Insulin pump therapy

The basal rate should be reduced by 20–40 % in the last 3 to 4 h of fasting. An increase of the basal dose by 0–30 % is recommended shortly after Iftar. The bolus dose should be administered depending on the carbohydrate amount consumed and the respective insulin sensitivity.

Quitting the fasting

Each patient should be informed about the possibility of quitting the fast. In particular, symptoms of hypoglycemia or hyperglycemia should be taken seriously and reacted to accordingly. In case of an unforeseeable event or an acute complication (e. g. acute illness, massive blood glucose derailment), fasting should be interrupted immediately. Fasting can be ended by ingesting a liquid containing carbohydrates or with solid food.

In the case of hypoglycemia with typical symptoms, prompt glucose measurement is recommended after an appropriate intake of fast-acting carbohydrates.

In case of unclear symptoms of blood glucose derailment (unclear differentiation between hypoglycemia and hyperglycemia) and refusal to break the fast, immediate glucose measurement is recommended and should be reacted to according to the values listed below.

All patients should interrupt fasting when [93]:

1. The glucose value is < 70 mg/dl (3.9 mmol/l)
2. The glucose value is > 300 mg/dl (16.7 mmol/l) and/or
3. Symptoms of hypoglycemia or an acute illness have occurred.

▶ **Tab. 3** Therapy dosage suggestions during the fasting period of Ramadan for the insulin therapy.

Therapy (Insulin) [35]	Adjustments	Dosage			Particularities
		One dose	Two doses	Three doses	
BOT – basal insulin-supported oral therapy	Dose adjustment	Dose reduction 15–30 %	Reduce the dose at Iftar[1] 15–30 % and reduce the dose at Sahur[2] by 50 %.	–	
	Administration	At Iftar	Move the morning dose to Iftar and move the evening dose to Sahur	–	
Rapid-acting insulin – functional insulin therapy	Dose adjustment	None	Iftar dose unchanged, reduce Sahur dose by 25–50 %	Reduce Sahur dose by 25–50 %	Analog insulin recommended
	Administration	At Iftar	Iftar and Sahur	Skip midday dose	
Mixed insulins	Dose adjustment	None	Reduce Sahur dose by 25–50 %	Reduce Sahur dose by 25–50 %	
	Administration	Move to Iftar	Move morning dose to Iftar, move evening dose to Sahur	Skip midday dose, otherwise the same as two doses	
Insulin pump	Dose adjustment	Reduce the basal rate by 20–40 % 3–4 h before Iftar, shortly after Iftar: increase by 0–30 %			Insulin bolus depends on carbohydrate amount and insulin sensitivity

[1] Iftar: Breaking the fast at sunset.; [2] Sahur: Start of fasting at sunrise.

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Conflicts of Interest

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