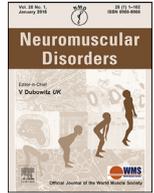




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Having an eye for myotonic dystrophy: A qualitative study on experiences and support needs in myotonic dystrophy type 1 patients with a diagnostic delay after early-onset cataract

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ABSTRACT

Myotonic dystrophy type 1 is a neuromuscular disorder affecting multiple organ systems and is characterized by a variety of clinical presentations. Anticipation leads to an earlier and more severe phenotype in subsequent generations. Early-onset cataract is a common initial manifestation of the late or adult-onset type of myotonic dystrophy 1. Due to its multicausal nature, early-onset cataract is often not recognized as a feature of this disease, leading to diagnostic delay resulting in consequences for successive generations, treatment and counseling. A qualitative study with semi-structured interviews was performed with purposive sampling of eight participants with myotonic dystrophy type 1 and early-onset cataract to investigate the physical and psychosocial consequences experienced due to diagnostic delay. Prior to the early-onset cataract, all participants experienced other multisystem symptoms that could have been explained by myotonic dystrophy. The diagnostic delay had severe hereditary consequences: a subsequent generation with more severely affected (grand)children was born resulting in large emotional burden for the patients. To conclude, early-onset cataract is a warning sign and ophthalmologists play a crucial role in the early detection of myotonic dystrophy type 1 by recognizing this symptom and preventing the birth of severely affected children leading to emotional and psychosocial consequences.

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1. Introduction

Myotonic dystrophy type 1 (DM1) is an autosomal dominant disorder, characterized by delayed relaxation of voluntary contracted muscles (myotonia) combined with slowly progressive muscle weakness (dystrophy) [1]. DM1 is caused by an expansion of a CTG triplet repeat in the DMPK gene [2]. Alongside muscles, multiple other organ systems may be involved [1]. Noteworthy is the phenomenon of anticipation in DM1, resulting in an increase in CTG repeat expansion and disease severity (mainly extramuscular symptoms) and decrease in age of onset in successive generations [3]. Four subtypes are associated with the onset of symptoms including late, adult, juvenile and congenital onset (Table 1).

The disease course is slowly progressive and therefore treatment aims at early detection of complications to reduce morbidity and mortality and prevention by means of genetic counseling in order to improve quality of life [4].

Early-onset cataract is defined as cataract with an onset before 50 years of age and could be a first manifestation of late or adult-onset subtype DM1. It is, however, often not recognized as such probably due to its multicausal nature [5–7]. A small prospective study in DM1 patients ($n = 42$) reported a prevalence of cataract of 90% with a mean age at cataract diagnosis of 40.2 (± 10.9 year) [8]. Furthermore, our research group reported a 24-year old female with cataract, which was not recognized as an early symptom of DM1, resulting in the birth of four children with juvenile-onset DM1 [9]. Hence, cataract is an objectifiable symptom and could therefore be a warning sign for the diagnosis DM1 and

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Table 1
Symptoms of DM1.

Type	Age of onset	Early symptoms	Late symptoms
Late	Around 50 years of age	Cataract	Myotonia Mild muscle weakness
Adult	12–50 years of age	Myotonia Muscle weakness (distal > proximal) Fatigue	Cataract Severe muscle weakness Lack of initiative, inertia Organ involvement
Juvenile	1–12 years of age	Gastro-intestinal complaints Cognitive and behavioral problems Speech problems Gastro-intestinal complaints	Myotonia Muscle weakness Lack of initiative, inertia Organ involvement
Congenital	At birth	Hypotonia, Dysphagia, breathing difficulties, speech problems Contractures Cognitive impairment	Myotonia Muscle weakness Lack of initiative, inertia Organ involvement

may prevent the unnoticeable inheritance and anticipation of this autosomal dominant disorder.

As described above, cataract and other extramuscular symptoms of DM1 are often not recognized by physicians as a manifestation of DM1. Little is known about the physical and psychosocial consequences experienced due to diagnostic delay in DM1 patients. Therefore, we conducted a qualitative study to gain insight in the physical and psychosocial consequences experienced by DM1 patients with early-onset cataract after diagnostic delay and their support needs. These insights may provide improvement of care and quality of life for this patient population.

2. Methods

2.1. Study design

We performed a qualitative study with semi-structured interviews to obtain insight in patients' experiences and reflections on the physical and psychosocial consequences of diagnostic delay and the support needs of DM1 patients.

The inclusion criteria were clinically or genetically confirmed DM1, age ≥ 18 years, early-onset cataract (onset before age of 50 years) for which no additional investigations had been initiated; a diagnostic delay of at least 1 year between the early-onset cataract diagnosis and DM1 diagnosis; DM1 diagnosed less than 10 years ago and Dutch speaking. We excluded patients with a first or second degree relative with DM1, who had deliberately refrained from diagnostic testing at the time of early-onset cataract and patients with severe cognitive impairments that could interfere with participation in the interview.

2.2. Recruitment

From February 2021 until April 2021, patients were recruited at the Radboud University Medical center by purposive sampling considering demographical differences and variation in diagnostic delay. Patients meeting the inclusion criteria, were approached and informed by the researcher (IK) during their annual visit at the Neurology outpatient clinic or actively over the phone. All participants were followed-up on by one of the researchers (IK and FS) the Radboud University Medical center. Patients received an information letter and were contacted by the researcher (IK) about the participation after two weeks.

2.3. Data collection

Data was collected with semi-structured interviews using video conferences and one by phone on patient's request using a literature-based topic list about DM1 care (Supplementary Table 1) composed by the neuromuscular experts in the research team (neurologist (NV), nurse practitioners (IK, FS)). All interviews were conducted by the same researcher (IK). Data collection continued until data saturation was reached, meaning each additional qualitative interview no longer provided new data, insights or opinions on the specific subject studied [10]. Patients were interviewed alone or with their partner. To improve interviewing skills, the first interview was reflected on by an experienced qualitative researcher (EC). Interpretation of the data was supplemented by notes on non-verbal communication. Data collection and analysis was iterative. Interviews were audio recorded and duration ranged between 29 and 68 min. Interviews were transcribed verbatim and anonymized (IK). Audio records were destroyed. Data collection and analysis were cyclically alternated to improve validity.

2.4. Data analysis

We used a hermeneutic phenomenological approach which is a scientific qualitative research methodology that aims to get insight in subjective experiences of the participants which is influenced by their individual contexts. Individual subjective experiences are influenced by the personal socio-cultural background, which is a key aspect in the hermeneutic phenomenological approach. Furthermore, researchers acknowledging their preconceptions and reflecting on how their subjectivity is part of the analysis process is a key point in the hermeneutic phenomenological approach [11].

Data was analyzed via inductive coding and consisted of three phases to indicate common themes among interviews. In the first phase, open coding was used to familiarize and manage the data. Transcripts were relistened and reread and open codes were assigned. In the second phase, axial coding, terms were identified, and relevant categories established. ATLAS.ti was used for data handling. In the final phase, selective coding, patterns and correlations were investigated between categories and described during axial coding. These concepts and themes were used to answer the objective. Results and interpretations were compared with literature leading to recommendations and a conclusion. The researcher performed all three phases. Coding of the interviews was performed by the researcher in consensus with an experienced

Table 2
Demographic characteristics of participants, DM1 = Myotonic Dystrophy type 1, EOC = early-onset cataract.

Patient	Sex	Current Age	Year EOC/age	Year of surgery	Year diagnosis MD1, age	Other possible causes for EOC*	Smoking	Duration of diagnostic delay (years)	Children or grandchildren with DM1	Multisystem symptoms prior to DM1 diagnosis
1	F	58	2004, age 42	2004	2018, age 56	No	Yes	14	One child with DM1 Multiple grandchildren of which none are tested	Muscle pain, muscle weakness, myotonia in hands, heart failure, cardiac arrhythmias (ICD implantation), fatigue, abnormal liver function Patient was diagnosed with Sjogren disease
2	F	64	2004, age 48	2004	2013, age 57	No	Yes	9	One child with DM1 No grandchildren	Hypersomnia, lack of concentration, palpitations, muscle weakness
3	F	42	2008, age 30	2010 Surgery postponed on patient's request	2012, age 34	No	No	4	Four children with DM1, No grandchildren	Fatigue, muscle and joint pain, frequent falling, gastro-intestinal complaints (diarrhea, incontinence), lack of initiative, difficulty maintaining friendships Uterus atony after childbirth Patient was diagnosed with myalgic encephalomyelitis
4	F	68	1977, age 25	1977	2017, age 65	No	Yes	40	Two children with DM1, One grandchild who is not tested	Fatigue, frequent falling, dysarthria
5	M	51	2010, age 41	2010	2014, age 45	Yes, diabetes mellitus 1	Yes	4	No children	Fatigue, hypersomnia, tripping/falling, lack of initiative, black and white thinking
6	F	38	2009, age 27	2009	2017, age 35	No	No	8	No grandchildren One child with MD1, two children not tested. No grandchildren	Gastro-intestinal complaints, myotonia in hands
7	M	69	1991, age 40	1991	2012, age 60	No	Yes	21	Two children with MD1 Five grandchildren with MD1	Muscle weakness and stiffness, gastro-intestinal complaints: diarrhea and incontinence
8	F	48	2012, age 40	2012	2016, age 44	No	Yes	4	No children No grandchildren	Muscle weakness, fatigue, hypersomnia, Lack of contractions during childbirth

* Other possible causes such as: corticosteroid use, diabetes mellitus type 1, maternal rubella infection during pregnancy, radiation treatment.

qualitative researcher (EC). Additionally, another professional was used as second coder (FS). Consensus was reached for different codes, to accomplish intersubjectivity. Finally, codes, themes and subthemes of all eight interviews were discussed in a meeting with different experts (neurologist (NV), nurse practitioners (IK, FS)).

2.5. Ethical considerations

This study was approved by the ethical committee of the Radboudumc (2020–7189). It was emphasized that participation in this study was voluntary and withdrawal from the study was possible at any time. All participants signed a written consent form.

3. Results

3.1. Study population

Eight patients fulfilling the inclusion criteria were invited and all agreed to participate. The female partners of the two patients joined the interview. After the eight interviews, data saturation was reached. Median age was 54.5 years and median diagnostic delay was 8.5 years. Table 2 shows an overview of the demographic characteristics.

Data analysis identified three overarching themes including: 1. Unexpected and unrecognized physical, cognitive and psychosocial consequences, 2. Inheritance and family, 3. Support needs. Table 3 shows an overview of the themes and subthemes.

3.2. Unexpected and unrecognized physical, cognitive and psychosocial consequences

3.2.1. Physical and cognitive symptoms prior to the diagnosis

Prior to the diagnosis, participants experienced a variety of physical symptoms that could retrospectively be explained by a DM1 diagnosis. All participants experienced muscle involvement (muscle weakness, stiffness, pain and frequent falling). Furthermore, fatigue and/or hypersomnia, gastrointestinal symptoms with or without fecal incontinence, cardiac symptoms, difficulties during delivery and anesthesia were reported.

"I was going to give birth at home, after a very pleasant pregnancy. My daughters head appeared and then the birth stopped. I had to rush to the hospital. They literally had to pull out my daughter because I no longer had any contractions [...] It was a traumatic experience!" (Participant 8)

Four participants had experienced cognitive symptoms before the diagnosis of DM1, including, lack of initiative, difficulty putting words into actions, decreased concentration, difficulties in comprehension and production of figurative language or other non-literal language, such as metaphor, an unsubtle, direct way of communicating and difficulty maintaining friendships. These were not recognized as part of the phenotype.

"It's all very black and white. [...] For instance, if I tell him to empty the washing machine, he will empty the washing machine into the laundry basket. Logically thinking, you would expect him to hang the laundry to dry. I have to mention it to him separately." (Partner participant 5)

Table 3
Themes and subthemes.

Themes	Subthemes
1. Unexpected and unrecognized physical, cognitive and psychosocial consequences	Physical and cognitive symptoms prior to the diagnosis Diagnosis provided clarity, relief and reassurance Unpleasant experiences and misunderstanding by social environment Various other diagnoses were set
2. Inheritance and family	Grief, concern and even guilt regarding the inheritance There are ways to prevent passing it on Struggles when informing family members
3. Support needs	Sufficient support regarding physical symptoms Need for psychological and emotional support Support need for partners The role of the expertise center Feelings of surprise and indignancy by the ignorance Need to increase awareness Patient organization for muscle disease (Spierziekten Nederland) and peer support

3.2.2. Diagnosis provided clarity, relief and reassurance

Prior to the DM1 diagnosis, patients considered various personal and environmental factors as causes for their symptoms, including: a busy family life, extra caregiving tasks, a physically demanding profession, a poor condition, a family trait, age or the menopause. The diagnosis provided clarity and relief. Overall, the participants did not experience a negative effect of the diagnostic delay on their physical symptoms. The annual check-up with the cardiologist, initiated in all patients after the diagnosis provided reassurance.

“The diagnosis is not an advantage for me, except for the fact that they check my heart annually. [...] and that they can prevent anything happening to my heart” (Participant 6)

3.2.3. Unpleasant experiences and misunderstanding by social environment

In the past, several participants reported unpleasant experiences regarding misunderstanding within their social environment about various symptoms. The diagnosis provided relief, because an explanation for the symptoms had been found, which led to more understanding from the patient's social peers.

“Everybody always felt that I was a drama queen”. (Participant 3)

“Just before the diagnosis we, or rather she anyway, wanted to divorce”. (Participant 5). “All the problems we were confronted with, were explained once DM1 was diagnosed”. (Partner participant 5)

3.2.4. Various other diagnoses were set

Most participants consulted their general practitioner repeatedly prior to the DM1 diagnosis. Several participants were subsequently referred to a medical specialist (rheumatologist, cardiologist or gastroenterologist) for various symptoms related to the multisystem involvement. Various other diagnoses were presumed to explain the symptoms (Sjogren's disease, myalgic encephalomyelitis). Furthermore, several diseases and sudden deaths in the family history were later related to the DM1 diagnosis.

“I still wonder about the diagnosis MS of my late sister, [...] if that diagnosis was correct, and if that S shouldn't have been a D.” (Participant 7)

3.3. Inheritance and family

3.3.1. Grief, concern and even guilt regarding the inheritance

As a result of the diagnostic delay, one or more children were born with DM1 in successive generations in five families, including children, grandchildren and nieces or nephews. These participants felt a great burden regarding the inheritance.

“We wanted to warn him (my brother). Be prepared that you may have DM1, and that you can pass it on. In our case unfortunately four

times. Then it appeared that my sister-in-law was expecting at about the same time we called him. So, their oldest child also has DM1.” (Participant 3)

These participants felt and experienced the serious consequences of this delay on a daily basis, causing a lot of grief and concern for the present and the future of their children and grandchildren.

“And what I think is even worse for my 5 grandchildren, 4 are mentally not well. I don't mind all 4 of them sitting in a wheelchair, I gladly push them. But that they are mentally as they are, I can't bear that. [...] When you are 12 and you can't read. Or that you don't understand the world around you, that other people don't understand you, that's heartbreaking! And that there are no schools the child can attend.” (Partner participant 7 about the consequences for her grandchildren)

Several participants felt responsible for passing the disease onto the subsequent generation, even though they were unaware of the diagnosis at time of having children, resulting in emotions of grief and/or guilt.

“It's all because of me, even though it's not my fault since I didn't know it. It's difficult to see it happen. That my children have got it, is awful. But that my grandchildren have it, really breaks my heart.” (Participant 7)

3.3.2. There are ways to prevent passing it on

When asked whether participants would have made different choices in life if they had received their diagnosis earlier, almost all answers were related to the consequences regarding family planning and prenatal diagnostics. Participants would rather have chosen not to have any children, no subsequent pregnancy, pre-implementation genetic testing or in the case of older participants, informing their adult children about possibilities for future pregnancies.

“My children are everything to me. But I really would have spared my child this misery. There are ways to prevent passing it on.” (Participant 6)

In contrast, participants who did not give birth to children with DM1 during the period of diagnosis of delay, dealt with this delay more resignedly.

“I found peace with it and that has everything to do with my daughter not having DM1 and is doing well.” (Participant 8)

3.3.3. Struggles when informing family members

Some participants admitted struggling with family members' choices regarding whether to test for DM1 or not, spontaneous pregnancies and seeking appropriate support, which effected family relationships. One participant reported a permanent break up with a family member. Other participants reported

reconciliation with family members and respect for family members' choices.

"My sister and her husband underwent a PGT-procedure three times to conceive their second child, it failed three times. [...] During the last procedure, they told me: If it doesn't work, we can always get pregnant in a natural way. [...] This was such a deep struggle personally: [...] We would do everything to get DM out of this world, I would do everything to help them get a second child, but I can't, and they struggle between not having a second child or take the risk getting pregnant the natural way." (Participant 6)

Participants felt very responsible the inheritance and for informing their family members.

"I didn't know because my ophthalmologist didn't look further. I don't want my family members to say later on: If I only had known." (Participant 6)

Not all first and second-degree family members felt the immediate need to test for the disease or postponed the screening because of the consequences of a definite diagnosis on life insurance or mortgage. One participant reported that a family member had not informed other family members about his diagnosis.

"An uncle of mine was diagnosed in 1980 already and he didn't tell the rest of the family. [...] I resented him for that. [...] I don't feel sorry for myself, but I do for my children!" (Participant 4)

3.4. Support needs

3.4.1. Sufficient support regarding physical symptoms

Most participants were referred to allied health care or rehabilitation centers, focusing on physical exercise and fatigue management. Additionally, participants were referred to different medical specialists to identify the multisystem involvement. One patient was implanted almost immediately a pacemaker after the diagnosis, although no symptoms were present suggesting any cardiac involvement. Participants reported sufficient support within this subtheme.

3.4.2. Need for psychological and emotional support

The need for psychological or emotional support or both was variable. Participants who had one or more (grand)children with DM1, required support regarding the consequences of the diagnostic delay and coping and processing the grief or guilt or both of passing on a hereditary disease. Moreover, there was a need for support due to the effect of DM1, accepting change in future prospect for their children and grandchildren and the change in roles (from parent to caregiver). Participants indicated that this support should be offered repeatedly due to differences in stages of emotional processing and lack of initiative by the patients. Two participants sought psychological support on their own initiative. Other participants with support requirements were referred to social workers and psychologists by the treating physician.

3.4.3. Support need for partners

Half of the participants and their partners expressed a need for support for their partner in particular. The wish for support was mainly regarding the effect of DM1 in daily life, accepting the change of future prospect for the patient and/or (grand)children and change in roles (from partner/parent to caregiver).

"Until three years ago, I did everything with my daughter. Her husband couldn't handle the situation. [...] I felt I had to help my daughter, but I couldn't do it anymore. I have visited a psychologist for 18 months. I slowly started to eliminate certain things I used to do for my daughter and her family." (Partner participant 7, regarding her role in her daughter's family with DM1)

3.4.4. The role of the expertise center

Three participants were initially not referred to an expertise center after diagnosis resulting into feelings of lack of support and information. Generally, participants were satisfied about the information and support received by the expertise center. It was experienced as valuable to visit a place where care givers are familiar with the disease, particularly because of the knowledge about the wide variety of symptoms in DM1 and the accessibility of the nurse practitioners.

"It's nice to have a place where people know what you are talking about. That is very valuable, especially with an elusive disease as DM." (Participant 6)

3.4.5. Feelings of surprise and indignancy by the ignorance

Overall, participants reported feelings of surprise and indignation about the ophthalmologist's unfamiliarity with the disease and anger towards the lack of examination into the cause of the cataract.

"I highly blame my doctor [...] it's just a weird situation when you diagnose someone with cataract at the age of 27. [...] I had already been examined for a million times for all kinds of bowel complaints. [...] It's just somewhere in my medical file!" (Participant 6)

3.4.6. Need to increase awareness

Patients shared several suggestions for improvement regarding support after DM1 was diagnosed, including advice on informing family members about the hereditary disorder (e.g., by an information letter by a genetic counselor) and support in providing feedback towards the ophthalmologist regarding the diagnostic delay.

"I hope there will be a paper that shows that I am not the only one [...]. That it will be presented to my ophthalmologist and that he realizes that I am not the only one. It's more common and it is a serious problem." (Participant 6)

Finally, suggestions about other topics were made, such as raising awareness for the expertise center and additional information about rehabilitation and complementary treatment approaches. Participation in scientific research was considered important by all participants; for them it is an important way to be able to contribute to the future of their children, grandchildren and other patients. Many of them consented in participation in the Dutch nation-wide register for DM1 (MYODRAFT study).

3.4.7. Patient organization for muscle disease (Spierziekten nederland) and peer contact

Most participants had become member of the Dutch patient organization for muscle disease (Spierziekten Nederland) after being diagnosed. This support group provides extensive additional information on their website. Only one participant expressed his/her interest in peer contact specifically about the diagnostic delay.

4. Discussion

This qualitative research investigated the physical and psychosocial consequences and support needs of DM1 patients with a diagnostic delay. All patients in this study were diagnosed with early-onset cataract which was at the time not identified as an early symptom of DM1, resulting in the birth of subsequent generations with an advanced type of DM1 and lack of (cardiologic) follow-up. Furthermore, due to this diagnostic delay patients experienced a large emotional and psychosocial burden. Additionally, patients and their partners wished to receive psychological support and guidance regarding this diagnostic delay and consequences experienced.

The 'Unexpected and unrecognized physical, cognitive and psychosocial consequences' theme showed that prior to the DM1 diagnosis, a variety of mainly physical symptoms were present such as muscle weakness and stiffness, myotonia, cardiac complaints, fatigue, hypersomnia and GI complaints, which is in line with previously performed research in DM [3,12,13]. A report on diagnostic delay in DM1 patients showed a mean delay in DM1 of 7.3 ± 8.2 years, consisting of a combined patient and doctor's delay [14]. Although all participants presented with muscle involvement in our study, none of the participants were initially referred to a neurologist. This might be related to the mild severity and slow progression and the so far negative family history related to the anticipation. Other, less specific physical or cognitive symptoms were not recognized as a DM1 symptom. Early-onset cataract was the first clearly defined and objective disease characteristic of DM1 in this cohort [7,9,15].

The largest burden of the diagnostic delay was found within the 'Inheritance and family' theme. An early diagnosis of DM1 has extensive consequences for family members. Participants with (grand)children born during the diagnostic delay felt that they were denied a choice regarding family planning or prenatal diagnostics due to the ophthalmologist's unfamiliarity with early-onset cataract as first symptom of DM1. This had resulted in feelings of grief, guilt, anger since no further investigation was conducted regarding the cause of the cataract.

The 'Support needs' theme showed that half of the participants received or wished to receive psychological support. The need for emotional support in DM1 had been reported before. 'The Christopher Project' investigated perspective of DM1 patients and their families [16]. Of all family members, 33% expressed a wish for some form of information and support regarding the complexity of the disease, emotional burden and coaching. The current international guidelines are an important framework for treatment of DM1. Notably, the psychological and emotional symptoms and consequences of DM1 receive only little attention in these guidelines. Furthermore, in this study half of the participants and their partners reported the wish for support for their partners. Additionally, not all participants were referred to an DM1 expertise center once diagnosed. Physicians involved in the diagnosis of DM1 and patients may not be aware of the existence of the expertise centers or may be unfamiliar with their localization [17]. The health care professionals in an expertise center have specific knowledge about DM1 and generally understand the emotional burden of the inheritance of the disease and its anticipatory character [18]. The expertise center may refer to a clinical genetics center which may provide support and guidance in informing family members.

Research into diagnostic delay in rare disorders is scarce. A Dutch research report using questionnaires and interviews to investigate the diagnostic delay in rare disorders (FSHD, DM1, Ehlers-Danlos, Duchenne muscular dystrophy, Marfan syndrome, osteogenesis imperfecta etc.) reported 56% of physical and 47% of psychological consequences amongst respondents due to the diagnostic delay such as poorer physical condition, worsening of the disease, lack of self-confidence and depression [17]. Two other studies describe a sense of abstinence of autonomy reported by patients regarding family planning during diagnostic delay [19,20].

Early detection of DM1 is important. A case report of a family with hereditary cataract, which turned out to be DM1 resulting in the birth four children with juvenile-onset DM1, shows the enormous impact on the parents and other family members who have to deal with this preventable progressive disease [9]. Several studies indicated that cataract is highly prevalent among DM1 patients, which already led in 1995 to the recommendation to screen patients with bilateral cataract before the age of 55 years without another explanation for

DM1 [8,21]. Our study underscores that diagnostic delay leads to a larger emotional burden. Hence, early-onset cataract is a well-defined disease characteristic of DM1 that could play an important role in timely recognition and prevention of psychosocial and emotional consequences of transmission of the disease. Ophthalmologist should consider DM1 as possible underlying disease when diagnosing a patient with early-onset cataract. Furthermore, general practitioners could play an important role in the early recognition of symptoms that may indicate DM1.

Another approach for early diagnosis is newborn screening. A recent study on the prevalence of CTG repeats in dry blood spots demonstrated that the prevalence of DM1 in newborns is five times higher than previously estimated, indicating that DM1 is underdiagnosed. This is probably due to the wide variation in clinical presentations and age of onset of the disease leading to underdiagnosed and undetected individuals with CTG repeats [22]. However, DM1 will not be included in the dried blood spot test for newborns until medical treatment becomes available. Hence, early diagnosis of DM1 is currently still depending on recognition of symptoms by e.g., general practitioners and pediatricians indicating a primary manifestation of the disease such as early-onset cataract or other symptoms (Table 1).

An early diagnosis of any genetic disease that cannot be cured creates a burden on the patient. However, due to the multiple organ system involvement of DM1 and the associated health risks early detection offers great benefit: systemic manifestations can already be treated when still asymptomatic and reproductive options can be discussed. This is illustrated by the observations in a large epidemiological study on DM1, showing a significant aging of the DM1 population over the past 25 years. This was presumably due to genetic counseling and thereby the prevention of new cases of congenital DM1 and the reduction of patient with juvenile and adult type DM1 [23].

This study has a number of limitations. The researcher who performed the interviews works at the center where participants were recruited. This may have induced hesitation in answering the interview questions. All participants were therefore explicitly invited to be outspoken. Vice versa, this approach could also be a strength since patients were likely to trust the interviewer and talk openly. Furthermore, participants may have found it difficult to remember retrospectively the onset of disease and their symptoms, resulting in a recall bias. Study results are based on patients' experiences with a diagnostic delay after a prior diagnosis of early-onset cataract, which may reduce generalizability in diagnostic delay to other non-objectifiable symptoms. Finally, this study has an overrepresentation of women (75% vs 50% in the MYODRAFT study). Cataract is more common in women however this was not specified by age, and it is therefore unclear whether this is also the case for early-onset cataract [24].

To conclude, early-onset cataract is a warning sign for DM1 and if recognised could decrease diagnostic delay and prevent the birth of children with a more severe form of DM1, with its emotional and psychosocial consequences. Ophthalmologists thus have a crucial role in diagnosing the disease and therefore awareness should be increased regarding this specific symptom for early diagnosis. Besides that, general practitioners and pediatricians should be aware of any symptoms or combination of symptoms which may indicate DM1. Furthermore, patients wished to receive some sort of psychological support regarding the diagnostic delay which the expertise center could provide. Finally, psychological and emotional symptoms and consequences of DM1 receive currently only little attention in the international guidelines of DM1 and it is therefore recommended to increase awareness on these subjects to improve quality of life in DM1 patients.

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Author agreement

All authors have agreed the contents of the submission.

Declaration of Competing interests

The authors report no competing interests.

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Supplementary materials

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