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Telemedicine in the treatment of gestational diabetes: An observational cohort study on pregnancy outcomes and maternal satisfaction

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Abstract

Aims: Gestational diabetes treatment requires several outpatient consultations from diagnosis until delivery in order to prevent hyperglycaemia, which is associated with maternal and fetal complications. There is limited evidence in the literature about telemedicine superiority in improving pregnancy outcomes for women with gestational diabetes. The primary aim of the study was to evaluate maternal and fetal outcomes, while the secondary aim was to estimate the degree of satisfaction with gestational diabetes treatment, comparing telemedicine versus outpatient care.

Methods: This observational cohort study involved 60 consecutive women with gestational diabetes treated at the Diabetology Unit of Ferrara: 27 were followed up through a weekly remote control method (telemedicine group) and 33 in ambulatory clinics every 2 or 3 weeks (conventional group). After giving birth, 56 women responded to the modified Oxford Maternity Diabetes Treatment Satisfaction Questionnaire to assess their satisfaction with diabetes care.

Results: No statistically significant differences were found in most of the maternal and neonatal parameters evaluated in both groups. The questionnaire scores were positive in all areas investigated. Telemedicine follow-up made women feel more controlled ($p = 0.045$) and fit better with their lifestyle ($p = 0.005$). It also emerged that almost all women treated with telemedicine would recommend this method to a relative or a friend.

Conclusions: Telemedicine follow-up proved to be safe both in terms of metabolic control and pregnancy outcomes; furthermore, it significantly decreased the need for outpatient consultations and increased women's satisfaction. Studying the impact of telemedicine is also necessary, considering the current difficulties associated with the Sars-COV-2 pandemic.

KEYWORDS

diabetes, pregnancy-induced, eHealth, gestational diabetes, telehealth

1 | INTRODUCTION

Gestational diabetes mellitus (GDM) is defined, according to the American Diabetes Association, as 'diabetes diagnosed in the second or third trimester of pregnancy that was not clearly overt diabetes prior to gestation'. In many cases, gestational diabetes regresses after childbirth; therefore, the available time to know and accept the condition is often insufficient.[1] Between 24 and 28 pregnancy weeks, the progressive increase in maternal hyperglycaemia is associated with short- and long-term risks.[2] Maternal complications include preeclampsia and caesarean section. Moreover, these women need to check their blood sugar levels after childbirth at least every 3 years due to the increased risk of developing type 2 diabetes, as the onset of gestational diabetes is often a sign of pancreatic beta cell dysfunction.[1] Fetal complications include an increased risk of macrosomia, neonatal hypoglycaemia, hyperbilirubinaemia, shoulder dystocia and birth trauma. Furthermore, fetal exposure to maternal gestational diabetes contributes to the development of abnormalities in glucose metabolism and obesity during childhood and adulthood, regardless of genetic predisposition.[3] In fact, fetal hyperinsulinaemia and neonatal adiposity, related to consistently elevated maternal glucose levels, are mediators of childhood body fat.[4]

The obstetric examinations frequency is increased in diabetic women. As a first instance, treatment of gestational diabetes involves changes in lifestyle (adequate diet and moderate physical activity) and requires a daily check of glucose levels to evaluate its effectiveness. Glucose values are conventionally recorded on specific diaries and shown at each consultation. Therefore, many outpatient accesses are indispensable to verify the adequacy of treatment and commence insulin treatment when indicated. The high number of prenatal checks has detrimental effects on both maternal compliance and psyche.[5,6] Furthermore, a percentage of women find it difficult to achieve their blood glucose targets. Several factors may be involved, such as personal beliefs about one's own health, a poor understanding of the importance of good glycaemic control, inability to perform a challenging regimen of blood glucose measurements (up to seven times a day) and the need to adjust insulin dosage.[7]

Telemedicine can be defined as a subgroup of remote clinical services that 'uses communication networks for the provision of health services and medical extension from one geographic location to another, primarily to address challenges such as uneven distribution and shortage of infrastructural and human resources'.[8] Telemedicine can potentially reduce the number of consultations and improve women's life quality, without increasing the occurrence of adverse neonatal and maternal outcomes.[9]

What's new?

- The treatment of gestational diabetes requires multiple consultations to achieve optimal glycaemic control. There is no consensus about telemedicine care superiority in reducing the number of consultations and improving quality of life. Moreover, there are limited data on women's satisfaction with telemedicine diabetes care.
- This study found no differences in clinical outcomes comparing conventional vs telemedicine care and found that telemedicine care makes women feel more controlled and fits better with their lifestyle.
- Studying the impact of telemedicine is also necessary, considering the current difficulties associated with the Sars-COV-2 pandemic.

Telemedicine has several effects, including overcoming the need for face-to-face consultations and improving the perception of a doctor who is more often available. A dimension that is often evaluated in relation to telemedicine is compliance, explained as the willingness to follow medical prescriptions (insulin treatment or the number of glucose measurements). Another relevant dimension is satisfaction with treatment and service, a multidimensional element that includes emotional and cognitive assessments. The quality of communication between patient and clinician is an influential key factor of satisfaction. Moreover, personal recording of health data promotes patient's empowerment. An empowered woman with GDM means that 'the patient should have a clear understanding of the disease, its pathogenesis, and its short- and long-term consequences for mother and child'.[10]

The current scientific literature is limited, and further results are needed to confirm the effectiveness and safety of telemedicine in gestational diabetes care. Furthermore, high-quality research is needed to strengthen existing evidence and determine the satisfaction of women and professionals.[11,12]

Following the introduction of telemedicine in diabetic services, the primary outcome of this study was to evaluate the maternal (weight gain, insulin therapy, pregnancy-related disease, mode and time of delivery, postpartum blood loss, shoulder dystocia) and fetal outcomes (birth weight, LGA infants, fetal macrosomia, hypoglycaemia, admission to the NICU, respiratory distress,

hyperbilirubinaemia and malformations); the secondary outcome was to estimate the degree of satisfaction in gestational diabetes treatment.

2 | METHODS

From February 2018 until August 2019, a closed observational cohort study was designed for women affected by gestational diabetes, comparing a group controlled by telemedicine and a group conventionally followed-up in ambulatory care in Ferrara (Italy). This study follows the recommendations of the STROBE Statement.[13]

Sixty consecutive women affected by gestational diabetes were enrolled into either the 'telemedicine group' or the 'conventional group'. The women chose which of the two follow-up methods to join, based on their technological skills and their degree of understanding of the Italian language, a fundamental condition for the tele-visit.

For the 'conventional group', the clinical follow-up took place at the Complex Operative Unit of Territorial Diabetology of Ferrara, with outpatient consultations every 2 or 3 weeks until delivery. For the 'telemedicine group', there was only one face-to-face medical examination on enrolment day, also including an interview with a dietitian. Most of the women gave birth at the Operative Unit of Gynecology and Obstetrics of the Sant' Anna University Hospital in Ferrara. The inclusion criteria were single pregnancy, age greater than 18 years of age and consent to participate.

Between the 24th and 28th gestational week, the diagnosis of gestational diabetes was made using an oral glucose tolerance test (OGTT) with 75 g of glucose in adult women without pre-existing diabetes. The 'telemedicine group' women were provided with a glucose meter, to perform daily four-point glucose level self-checks (fasting and 1 h after the three main meals), automatically transferred to a virtual cloud through an application downloaded on their smartphone. Every week, the same diabetologist checked all 'telemedicine group' values on the telematic platform, verifying the achievement of glycaemic targets (fasting <90 mg/dL–<5 mmol/L, 1 h after a meal <130 mg/dL–<7.2 mmol/L). In cases of achievement of the targets, the diabetologist carried out one telemedicine visit per month; in cases of persistent off-target values, women started insulin therapy and were checked every 2 or 3 weeks.

Finally, in October 2020, women were contacted by phone to answer the Questions and Responses to the Oxford Maternity Diabetes Treatment Satisfaction Questionnaire (OMDTSQ), made by Hirst et al.,[14] which was modified ad hoc and translated into Italian language (Table 1).

For both groups, the following variables were evaluated: age, parity, pre-pregnancy BMI (body mass index), HbA1c (glycated haemoglobin) at diagnosis, gestational week at diagnosis of diabetes and native Italian language. The obstetric variables were: weight gain at the end of pregnancy, insulin therapy, number of consultations performed, pregnancy-related disease (gestational hypertension, preeclampsia, intrauterine growth restriction-IUGR, cholestasis), induction of labour, time and mode of delivery (spontaneous delivery, caesarean section), postpartum blood loss and occurrence of shoulder dystocia.

The neonatal outcomes evaluated were birth weight, large for gestational age (LGA) infants, fetal macrosomia, hypoglycaemia at birth, admission to the Neonatal Intensive Care Unit (NICU), respiratory distress, hyperbilirubinaemia and any malformations.

A phone interview investigated satisfaction for diabetes care as the secondary outcome. In the first part of the survey, women had to assess their agreement with the nine statements of the modified-OMDTSQ: general satisfaction with diabetes care, perception of the relationship with the diabetes team and satisfaction with the technology used, giving a score on a seven-point Likert-type scale (from +3 stands if strongly agreeing to −3 stands if strongly disagreeing). In the second part of the interview, they were questioned about the number of consultations, their adherence to glucose level monitoring and postpartum OGTT; at last, only the 'telemedicine group' participants were asked if they would recommend this method to friends or relatives with gestational diabetes (Table 1).

Glycaemic control data were retrieved from the computer databases used by the diabetes service through a virtual cloud for the telemedicine group and based on the values recorded by the glucose meter for the conventional group. The maternal and neonatal clinical data were obtained from the medical records of the deliveries taking place at the study centre. In one case in the telemedicine group, the woman had given birth in a different hospital, so data were retrieved from the discharge letter. The same investigator submitted the questionnaire to all participants. The same diabetologist treated the telemedicine group, while different diabetologists treated participants in the conventional group. This is a potential bias that is intrinsic to the study design. The sample size was calculated in order to detect differences of at least 33% in the clinical outcomes between the two groups. The sample size was calculated to be at least 58 patients, with an 80% of power and 95% significance, to have a type 1-alfa error of 0.05 and a type 2-beta error of 0.20.

TABLE 1 The Oxford Maternity Diabetes Treatment Satisfaction Questionnaire (OMDTSQ) modified by authors.

	Strongly disagree (−3)	Disagree (−2)	Mildly disagree (−1)	Neutral (0)	Mildly agree (+1)	Agree (+2)	Strongly agree (+3)
Women's overall satisfaction with gestational diabetes care							
1. I am satisfied with my current treatment							
2. I am satisfied the treatment I am receiving is the best for me							
3. I am satisfied with my understanding of diabetes							
Relationship with the diabetes clinical care team							
4. I feel my maternity diabetes team knows enough about my current level of diabetes control							
5. I feel I have a good relationship with my maternity diabetes team							
6. I am satisfied with my maternity diabetes team's understanding of my diabetes							
Satisfaction with the Gestational Diabetes-health system							
7. I find the equipment I use to check my blood sugars is convenient							
8. I feel the equipment I use to check my blood sugars is reliable							
9. My blood sugar monitoring fits in with my lifestyle							
10. I believe the number of diabetic visits was	Few (1)	Proper (2)	Too Many (3)				
11. I performed daily blood glucose checks as advised	Always (1)	Sometimes (2)	Almost Never (3)	Never (4)			
12. Do you perform the postpartum OGTT?	Yes (1)	No (2)					
13. FOR TELEMEDICINE GROUP Would you recommend telemedicine in the management of gestational diabetes to a relative or friend with gestational diabetes?	Yes	No					

Note: No.1–9 statements were translated into Italian from the original OMDTSQ by Hirst et al.[14] and women declared their concordance assigning a score on a Likert-type scale (from +3 to −3). No. 10–12 statements were added by the authors and women expressed their agreement by quantitative answers; the authors assigned to each answer a score, in order to compare the results, as shown.

Abbreviation: OGTT, oral glucose tolerance test.

2.1 | Statistical analysis

A p value <0.05 was set to find significant differences between the two groups using MedCalc Software Ltd. Continuous variables are shown as the mean with standard deviation (SD) and categorical variables as frequencies and percentages.

The two-sided t test was used to compare the continuous variables; the Chi-square test was employed for the analysis of the observed frequencies while, for smaller samples, the Fisher's exact test was used.

For the modified-OMDTSQ, the score means were compared using the Mann–Whitney test for independent samples. Adjustments were made for multiplicity and potential confounding factors (pre-pregnancy BMI, age, telemedicine, use of insulin, time of delivery, gestational week at diagnosis of diabetes, admission to NICU), through a logistic regression analysis.

3 | RESULTS

From February 2018 to August 2019, 73 women were selected after gestational diabetes diagnosis based on OGTT positivity performed between the 24th and 28th gestational week; eleven patients were excluded (nine did not attend their consultations and two had twin pregnancies). Among the 62 women enrolled, two interrupted the follow-up after having their care transferred to different hospitals; therefore, there were 33 participants in the conventional group and 27 in the telemedicine group. Fifty-six participants took part in the postpartum telephone survey (Figure 1).

The two groups had similar demographic characteristics ($p > 0.05$), as shown in Table 2; most participants in both groups were under 35 years old, nulliparous, overweight (pre-pregnancy BMI mean was 25 kg/m^2) and had normal HbA1c values at the beginning of pregnancy. In the conventional group, five women spoke a native language other than Italian. Regarding maternal outcomes (Table 3), there were no differences between the two groups in any of the variables under consideration: the need for insulin treatment and dosage, pregnancy-related disease, obstetric emergencies, mode and time of delivery ($p > 0.05$). Telemedicine permitted to achieve optimal glycaemic targets and saved time for each patient (65 versus 97 min per patient respectively, $p < 0.001$, Table 3).

There were no significant differences in terms of neonatal outcomes, including birth weight, rate of LGA, macrosomia, admission to the NICU and other variables ($p > 0.05$; Table 4).

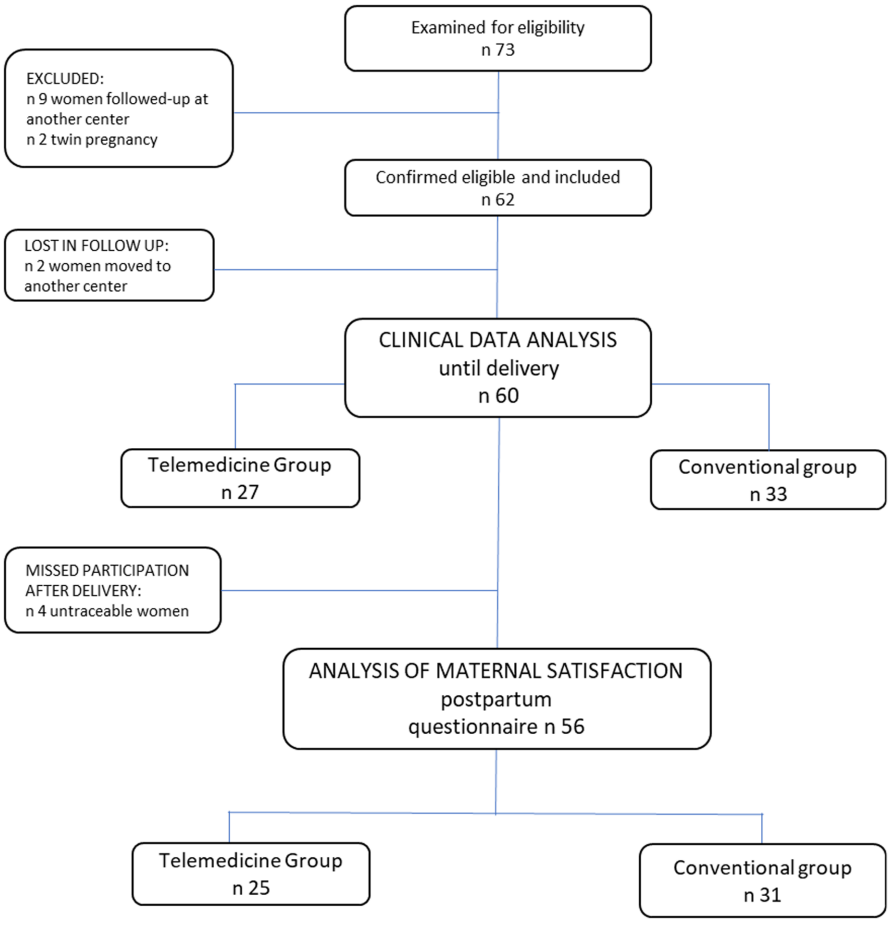

FIGURE 1 Participants selection. In the first phase, the women were enrolled at the time of gestational diabetes diagnosis and then divided into two groups (one followed-up by telemedicine and one by outpatient consultations, the conventional method). Follow-up was until delivery, with collection of obstetric, diabetic and neonatal clinical data. At least 6 months after delivery, they were contacted by phone to assess their satisfaction with gestational diabetes treatment, using the modified-OMDTSQ.

TABLE 2 Baseline characteristics of the participants.

	Telemedicine group ($n=27$)	Conventional group ($n=33$)	p value (<0.05)
Age, years	33 (5.3)	34 (5.5)	0.471
≥35 years	12 (44%)	12 (36%)	0.528
Parity	0.4 (0.6)	0.5 (0.6)	0.587
Nulliparous	19 (70%)	19 (58%)	0.306
Pre-pregnancy BMI, kg/m^2	25.2 (4.3)	25.0 (4.1)	0.843
HbA_{1c} at diagnosis, mmol/mol	34 (4)	34 (4)	0.729
HbA_{1c} at diagnosis, %	5.3 (2.5)	5.3 (2.5)	
Gestational age at diagnosis, week	26.1 (2.0)	25.4 (1.3)	0.081
Native Italian language	27 (100%)	28 (85%)	0.058

Note: Continuous variables: mean (SD), categorical variables: *n* (%).

Abbreviations: BMI, body mass index; HbA1c, glycated haemoglobin.

TABLE 3 Maternal outcomes.

	Telemedicine group ($n=27$)	Conventional group ($n=33$)	p value (<0.05)
Weight gain, kg	10.3 (5.0)	11.2 (6.7)	0.583
Insulin therapy	4 (15%)	2 (6%)	0.394
Insulin dose, UI	10.3 (2.6)	11.5 (3.5)	0.643
Total time for consultations, minutes	65 (21.9)	97 (0.8)	<0.001
Pregnancy disease			
Gestational hypertension	1 (4%)	2 (6%)	0.366
Preeclampsia	/	1 (3%)	
IUGR	/	/	
Cholestasis	/	1 (3%)	
Induction of labour	12 (44%)	13 (39%)	
Time of delivery, gestational week	39 (1.2)	39 (1.2)	0.695
Preterm birth	2 (7%)	1 (3%)	0.600
Caesarean section	8 (30%)	9 (27%)	0.583
Post-partum blood loss, ml	459.6 (562.5)	313.8 (224.8)	0.842
Cases of shoulder dystocia	/	/	

Note: Continuous variables: mean (SD), categorical variables: *n* (%).

Abbreviation: IUGR, intrauterine growth restriction.

For the OMDTSQ first nine statements, most women gave positive scores (+2 and +3) except for question no. 3 ('I am satisfied with my knowledge on gestational diabetes') and question no. 9 ('This blood glucose monitoring has adapted to my lifestyle'), in which the scores distributed towards more negative values. The maximum negative score (−3) was recorded in the conventional group, especially about the relationship with the team. It should be noted that for most respondents, the number of consultations were adequate and there was good compliance with daily glucose measurements. Postpartum OGTT was not performed by 24% of women in telemedicine group and 39% in conventional group (6 vs. 12 women, respectively, $p>0.05$). In the telemedicine group, 96% of respondents said they would recommend it to relatives and friends. All data collected by modified-OMDTSQ are shown in Appendix A.

Women in the telemedicine group reached the highest scores in all answers (Table 5), with statistical significance for the following statements: 'I felt well

TABLE 4 Neonatal outcomes.

	Telemedicine group ($n=27$)	Conventional group ($n=33$)	p value (<0.05)
Birth weight, g	3324 (438.6)	3301 (443.1)	0.845
LGA Infants	5 (19%)	4 (12%)	0.493
Fetal macrosomia	2(7%)	3(9%)	1
Hypoglycaemia at birth	/	/	/
Admission to NICU	6 (22%)	2 (6%)	0.123
Respiratory distress	3 (11%)	1 (3%)	0.317
Hyperbilirubinaemia	6 (22%)	3 (9%)	0.275
Malformations	3 (11%)	4 (12%)	1

Note: Continuous variables: mean (SD), categorical variables: *n* (%). LGA: large for gestational age, >90° centile following Neonatal Anthropometric Charts: The Italian neonatal study compared with other European studies. Bertino et al.[15] Fetal macrosomia: birth weight >4000 g; Hypoglycaemia: <47 mg/dL (<2.6 mmol/L). NICU: Neonatal Intensive Care Unit. Malformations (more than one for patient) in telemedicine group: pyloric stenosis, macrocephaly and varus metatarsus, heart muscle interventricular defect, short lingual frenulum; in the conventional group: short lingual frenulum and hypospadias, feet bilateral syndactyly, buried penis, undescended testicle.

TABLE 5 Modified-OMDTSQ results.

	Telemedicine group ($n=25$)	Conventional group ($n=31$)	p value[a] (<0.05)
Overall satisfaction with gestational diabetes care			
1. I am satisfied with my current **treatment**	2.4 (1.0)	2.4 (0.8)	0.649
2. I am satisfied the treatment I am receiving is the **best for me**	2.3 (1.2)	2.0 (1.2)	0.090
3. I am satisfied with **my understanding** of diabetes	2.2 (1.2)	2.1 (1.2)	0.759
Relationship with the diabetes clinical care team			
4. I feel my maternity diabetes team knows enough about my current **level** of diabetes **control**	2.6 (0.9)	2.5 (1.2)	0.356
5. I feel I have a **good relationship** with my maternity diabetes team	2.5 (1.0)	2.2 (1.4)	0.419
6. I am satisfied with my maternity diabetes **team's understanding** of my diabetes	2.8 (0.8)	2.2 (1.4)	0.003
Satisfaction with the gestational diabetes-health system			
7. I find the equipment I use to check my blood sugars is **convenient**	2.7 (0.7)	2.4 (0.8)	0.088
8. I feel the equipment I use to check my blood sugars is **reliable**	2.3 (1)	2.3 (1)	0.993
9. My blood sugar monitoring fits in with **my lifestyle**	2.2 (1.1)	1.2 (1.5)	0.001
10. I believe the **number** of diabetic visits was	2.0 (0.2)	2.1 (0.4)	0.193
11. I performed **daily blood glucose** checks as advised	1.1 (0.3)	1.1 (0.2)	0.824
12. Do you perform the **postpartum** OGTT?	1.2 (0.4)	1.4 (0.5)	0.245

Note: Data presented as mean (SD).

Abbreviation: OGTT, oral glucose tolerance test.

[a]Mann–Whitney's test for independent samples.

controlled by the diabetes team' ($p=0.045$) and 'This blood glucose monitor has adapted to my lifestyle' ($p=0.005$). Overall, the questionnaire did not show a greater degree of satisfaction for one of the two groups, even when this degree of satisfaction was adjusted by multivariate analysis for potential confounding factors ($p>0.05$).

4 | DISCUSSION

This study pointed out the impact of telemedicine on gestational diabetes care, comparing the telemedicine method with conventional face-to-face consultations; results revealed that there were no significant differences in maternal and fetal outcomes. Telemedicine therefore

proved not to be inferior to conventional management of GDM, substantially reducing the number of outpatient appointments while increasing the number of weekly glucose checks at the same time using a virtual platform. Regarding maternal satisfaction in gestational diabetes care, our secondary outcome, this study found that women in the telemedicine group felt better controlled and that this method adapted better to their lifestyle in comparison to those resorting to conventional consultations. To the best of our knowledge, this is the first study on maternal satisfaction comparing telemedicine and conventional follow-up appointments using a previously validated ad hoc questionnaire for GDM.

The principal limitation of this observational study is its small sample size. Although the two groups had similar baseline characteristics, the results should ideally be confirmed with a larger sample. Furthermore, the choice of providing the questionnaire through a telephone interview may have biased the interpretation of the answers, especially by women who were not native Italian speakers in the conventional group. Another limitation is that a cost analysis has not been performed to evaluate the cost-effectiveness of telemedicine.

The non-inferiority of telemedicine on maternal and fetal outcomes has been previously reported in the literature. In fact, according to a 2017 Cochrane review of five randomised controlled trials, no clear differences in obstetric (preeclampsia or hypertension, caesarean section or induction of labour) or neonatal outcomes (LGA infants, hypoglycaemia, severe morbidity and neonatal death) were found.[16] A 2020 meta-analysis by Xie et al. showed partial positive effects of telemedicine on glycaemic and pregnancy outcomes, but the evidence was deemed insufficient with regards to neonatal outcomes (macrosomia, neonatal hypoglycaemia, admission to the NICU, neonatal jaundice or hyperbilirubinaemia, and neonatal acute respiratory distress syndrome), so further research is still needed.[12]

According to the 2019 systematic review on the psychological dimensions in telemedicine care for GDM by Fantinelli et al., satisfaction has been evaluated in many ways, and positive outcomes were reported in several studies.[10] However, this is the first study in the literature that measures maternal satisfaction on gestational diabetes care with an ad hoc questionnaire. We adopted the modified-OMDTSQ questionnaire, originally created and validated on women treated with telemedicine by Hirst et al.[14] Among previously published studies, Dalfrà et al. examined the quality of life comparing pregnant women with type 1 diabetes and women with gestational diabetes followed with telemedicine and usual care (the control group); during pregnancy and after delivery, the authors used four questionnaires to measure health-related quality of life, depression and diabetes-related stress, showing no significant differences in any of the areas investigated. The authors did not use a specific questionnaire of satisfaction and data from women with type 1diabetes and gestational diabetes are pooled.[17]

This study also aimed at investigating whether telemedicine would improve postpartum monitoring, with results showing that nearly a third of women did not perform an OGTT after giving birth. The absence of a telemedicine system providing a supportive and monitoring role after delivery was emphasised by Farinelli et al.; they also suggested a telemedicine system capable of producing reminders for medical appointments after birth.[10] A 2022 systematic review highlighted the benefits of telemedicine, such as increased satisfaction and acceptability, but did not explore the post-natal period. In the authors' opinion, this limitation does not allow us to deduce whether the use of technology reduces maternal or neonatal risks associated with the post-partum period.[18]

Currently, this type of remote management has become extremely useful in clinical practice because of the limitations secondary to the Sars-COV-2 pandemic and our results suggest that it is a model of care that should be promoted now that the pandemic-related restrictions have been largely eased off. While evaluating a larger sample would be advisable, our results show that telemedicine improves the accessibility to care for pregnant women since it increases the number of contacts, allowing, when necessary, for timely intervention. Importantly, it reduces the need for outpatient appointments. It can therefore be considered a useful tool in the treatment of women with GDM, especially for those patients where rigorous glycaemic control is needed or where geographical difficulties restricting access to medical care. The strength of this therapeutic approach lies in its ability to increase the efficiency of care while maintaining its high quality and increasing women's satisfaction in terms of ease of use, reliability and perceived support.

AUTHOR CONTRIBUTIONS

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Sara Montori, Francesca Lugli, Elena Forini and Rosita Verteramo. The first draft of the manuscript was written by Sara Montori, Francesca Lugli and Rosita Verteramo and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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All the authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT
The datasets analysed during the current study are available from the corresponding author on reasonable request.

ETHICS STATEMENT
This study was performed in line with the principles of the Declaration of Helsinki. This study received the approval by the Single Ethics Committee of the Province of Ferrara, reference number 170996 on 14 December 2017 and the approval of the amendment with reference number EM661-2020 AUSLFe/170,996_EM1 on 28 July 2020 by the Ethics Committee of the Area Vasta Emilia Centro.

CONSENT FOR PUBLICATION
Not applicable.

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APPENDIX A

The OMDTSQ results: The data presented as score obtained for each sentences in the two groups

	Telemedicine group ($n=25$)							Conventional group ($n=31$)						
	−3	**−2**	**−1**	**0**	**+1**	**+2**	**+3**	**−3**	**−2**	**−1**	**0**	**+1**	**+2**	**+3**
Women's overall satisfaction with gestational diabetes care														
1. I am satisfied with my current treatment	0	0	1	0	2	7	15	0	0	0	1	2	12	16
2. I am satisfied the treatment I am receiving is the best for me	0	0	2	0	2	5	16	1	0	0	0	5	14	11
3. I am satisfied with my understanding of diabetes	0	0	1	2	3	5	14	0	0	2	2	4	7	16
Relationship with the diabetes clinical care team														
4. I feel my maternity diabetes team knows enough about my current level of diabetes control	0	0	1	0	0	5	19	1	0	0	0	1	9	20
5. I feel I have a good relationship with my maternity diabetes team	0	0	1	0	2	4	18	1	0	1	2	0	8	19
6. I am satisfied with my maternity diabetes team's understanding of my diabetes	0	0	1	0	0	1	23	1	0	1	1	2	9	17
Satisfaction with the Gestational Diabetes-health system														
7. I find the equipment I use to check my blood sugars is convenient	0	0	0	1	0	5	19	0	0	0	0	5	9	17
8. I feel the equipment I use to check my blood sugars is reliable	0	0	1	0	4	6	14	0	0	0	3	2	9	17
9. My blood sugar monitoring fits in with my lifestyle	0	0	1	2	1	7	14	2	0	1	3	10	11	4
	Few (=1)		Proper (=2)		Too Many (=3)			Few (=1)		Proper (=2)		Too Many (=3)		
10. I believe the number of diabetic visits was	1		24		0			1		27		3		
	Always (=1)		Sometimes (=2)		Almost Never (=3)		Never (=4)	Always (=1)		Sometimes (=2)		Almost Never (=3)		Never (=4)

	Telemedicine group ($n = 25$)							Conventional group ($n = 31$)						
	−3	**−2**	**−1**	**0**	**+1**	**+2**	**+3**	**−3**	**−2**	**−1**	**0**	**+1**	**+2**	**+3**
11. I performed daily blood glucose checks as advised	23		2		0		0	29		2		0		0
	Yes (=1)				No (=2)			Yes (=1)				No (=2)		
12. Do you perform the postpartum OGTT?	19				6			19				12		
13. FOR TELEMEDICINE GROUP Would you recommend telemedicine in the management of gestational diabetes to a relative or friend with gestational diabetes?	24				1									