



Diagnosis of Gestational Diabetes: a 'Teachable Moment'

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Research Article Educational and Psychological Aspects

Diagnosis of gestational diabetes: a ‘teachable moment’

J. Okely,¹ C. Mason¹ A. Collier,² N. Dunnachie² and V. Swanson¹

¹Psychology Division, University of Stirling, Stirling and ²University Hospital Ayr, Ayr, UK

Correspondence to: Judith Okely. E-mail: judy.okely@ed.ac.uk

The abstract for this study was published in the European Health Psychology (2016) conference abstract programme.

What’s new?

- Research regarding the determinants of effective gestational diabetes mellitus (GDM) self-management is limited.

- We tested whether the psychosocial changes outlined in the teachable moments model (a model of behaviour change) are associated with following GDM management recommendations during pregnancy.
- Higher perceived risk of complications during pregnancy and feeling supported by family or friends was associated with higher levels of concordance with GDM management recommendations.

Abstract

Aims Research regarding the determinants of concordance with gestational diabetes mellitus (GDM) treatment is limited. Here, we test whether the psychosocial changes outlined in the teachable moments model, as proposed by McBride *et al.*, Emmons and Lipkus, (McBride CM, Emmons KM, Lipkus IM. Understanding the potential of teachable moments: the case of smoking cessation. *Health Educ Res* 2003; 18: 156–170) are associated with following GDM treatment recommendations.

Methods Fifty-nine ~~participants-women~~ completed a baseline questionnaire (~~+1~~ week after GDM diagnosis) in which they reported risk perception, social support, emotional response, the importance of their maternal identity and self-efficacy. One month later, participants reported their concordance with instructions regarding glucose monitoring, diet and, if ~~applicable-applicable~~, medication. We used regression analysis to test for associations between the psychosocial factors measured at baseline and concordance at ~~+1~~-month follow-up.

Results ~~Participants-Those~~ who perceived their risk as higher or felt supported by family or friends were more likely to report a high level of concordance with GDM treatment. Emotional response, identity salience and self-efficacy were not related to concordance.

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6 **Conclusions** Future interventions designed to increase concordance could benefit from a
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8 focus on risk perception and social support, as these factors appear to be most strongly
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10 associated with following GDM treatment recommendations.
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13 14 15 <H1>Introduction

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17 The prevalence of ~~Gestational-gestational Diabetes-diabetes Mellitus-mellitus~~ (GDM) is
18 increasing in the UK, due to a rise in obesity, and other risk factors including advanced
19 ~~maternal age [2]. If poorly controlled, This this condition, if poorly controlled,~~ is linked to a
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21 range of perinatal complications for the developing foetus and mother [3,4]. GDM is also
22
23 associated with an increased ~~risk-risk~~ for both mother and ~~child-child~~ of developing obesity
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25 and ~~type-Type~~ 2 diabetes later in life [5–7]. Managing GDM can be a demanding experience.
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27 Women are advised to modify their diet and lifestyle. If hyperglycaemia persists, additional
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29 pharmacological intervention may be required (predominantly metformin or insulin) and
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31 women are advised to monitor their glucose ~~levels-levels~~, sometimes more than four times a
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33 day. In addition to these practical challenges, research indicates that a diagnosis of GDM can
34
35 be a difficult experience emotionally. Loss of self-esteem, ~~autonomy-autonomy~~, and feelings
36
37 of guilt and fear are common experiences among women diagnosed with GDM [8,9].
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40 ~~Because of Due to~~ the complexity involved in managing the condition, women with GDM
41
42 require effective support and education. However, knowledge regarding the psychosocial and
43
44 practical barriers to effective blood glucose management is limited [10]. With a view to
45
46 addressing this gap in the research, the aim of ~~the-current-this~~ study was first, ~~ly~~ to describe
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48 the psychosocial consequences of a GDM diagnosis and, ~~secondly~~, to test how these
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50 psychosocial factors impact on concordance with GDM treatment.
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7 ~~In order to~~ identify psychosocial factors relevant to health behaviour change in the GDM
8 population, we employed McBride, ~~Emmons and Lipkus'~~ *et al.*'s [11] 'teachable moment'
9 model [11]. The teachable moment model outlines how an event such as diagnosis can
10 impact on three important determinants of behaviour change. Specifically, a teachable
11 moment is ~~characterised~~ *characterized* by an increase in risk perception, a strong affective or
12 emotional response (either positive or negative) and a change in or challenge to a social role
13 or identity. It is proposed that these cognitive responses lead to an increase in motivation,
14 self-efficacy and skill acquisition, which in turn increase the probability that an individual
15 will engage in ~~health~~ *health*-protective behaviours [11]. We predicted that ~~participants~~
16 *women* who experienced the changes outlined in the teachable moment model would be more
17 likely to follow GDM treatment recommendations.

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27 <H1>Participants and ~~Methods~~ *methods*

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30 A previous study into the determinants of concordance with a diabetes regimen, reported
31 effect sizes (f^2) of ~0.18 [12]. Assuming we would observe similar effect sizes in our study,
32 we needed a sample size of 80 to achieve 80% power. Participants were recruited from ~~2~~ *two*
33 maternity outpatient units in the west of Scotland ~~approximately ~ 1-1~~ week after being
34 diagnosed with GDM (between 24- ~~and~~ 28 weeks of pregnancy). We were able to increase
35 the number of participants in our study by extending the initial recruitment period from ~~three~~
36 *3* to ~~nine~~ *9* months. However, our final sample size of 59 was below our initial target of 80
37 *participants*.

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Written consent was obtained from all participants. This study was given a positive opinion
by the East of Scotland ~~Research~~ *Research* ~~Ethics~~ *Ethics* Service and was approved by NHS
Ayrshire and Arran R&D Department.

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6 Participants were asked to complete ~~2~~two questionnaires, the first (pen and paper)
7 questionnaire was administered at the time of recruitment (~~1~~1 week following diagnosis),
8 and the second was administered over the telephone and completed ~~1~~1 month later. Both
9 questionnaires are ~~provided~~given in the Appendix.

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14 The first questionnaire was designed to measure the components outlined in the teachable
15 moment model; ~~namely~~namely, an affective or emotional response, perceived risk and
16 change in social identity. We additionally assessed level of perceived social support, intention
17 to follow ~~to~~ dietary and ~~glucose~~glucose-monitoring ~~guidelines~~guidelines, and self-efficacy
18 (~~operationalised~~operationalized as perceived confidence). We chose to include these
19 additional factors ~~as~~because they have previously been associated with successful behaviour
20 change during pregnancy [13,14].
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28 Affective or emotional response to GDM diagnosis, hereafter referred to as affective response,
29 was measured ~~with~~using an abridged ~~6~~six-item version of MacLeod and Hagan's Post
30 Diagnostic Mood Assessment Questionnaire [15] (the original questionnaire consists of 14
31 items, we narrowed this down to ~~6~~six by excluding those with overlapping content). The
32 questionnaire used in our study consisted of ~~3~~three questions regarding change in negative
33 affect and ~~3~~three ~~questions~~ regarding change in anxiety. Response options were: 'much
34 worse', 'moderately worse', 'slightly worse' 'no difference', 'slightly better', 'moderately
35 better' and 'much better'. Responses were scored on a scale of ~~-~~-6 to +6 with lower scores
36 indicating an increase in negative affect or anxiety. Individual item scores were summed to
37 create an overall affective response score. The reliability of this scale was high [16].
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47 Risk perception was measured with an adapted version of Heaman and Gupton's Perception
48 of Pregnancy Risk Questionnaire [17]. This consisted of four questions, regarding the
49 participant's perceived risk of complications (for themselves and their baby). Participants
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6 were asked to estimate the risk of complications, assuming their blood glucose was well
7 controlled, and, separately, assuming their blood glucose was poorly controlled. Response
8 options were: 'no risk at all', 'quite low risk', 'medium risk', 'quite high risk' and 'very high
9 risk'. Responses to each item were scored on a scale of 0–4 (higher scores representing
10 higher risk) and summed to create an overall risk perception score. Reliability of this scale
11 was high [16].

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18 According to the teachable moment model, a change in or challenge to a particular social
19 identity may motivate individuals to engage in behaviour change. Pregnancy marks the
20 adoption of a new social identity namely that of 'mother to be'. We predicted that women
21 who placed greater importance on this identity would be more likely to follow to advice
22 about GDM management. ~~As-Because~~ there are no available measures of identity in
23 pregnancy, we used an adapted version of 'The Pie' – an identity measure developed by
24 Touliatous, ~~Perlmutter and Straus~~ et al. [18]. This measure consisted of one item: 'Think of
25 who you are as a person, and the many identities (for example: friend, worker, sister,
26 neighbour, mother) that make up who you are, yourself. How important to you is your
27 identity as ~~“mother to be”~~ “mother to be-be” at this point in your life?' Response options were 'not
28 important at all', 'not very important', 'quite important' and 'very important'. These
29 responses were scored on a scale of 0 to 3 with higher scores indicating greater importance.

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41 For brevity and to enhance participation, social support, intention and self-management self-
42 efficacy were assessed with one item each. For the social support item, participants were
43 asked to indicate the extent to which they felt supported (by family or friends) in fulfilling the
44 responsibilities associated with their pregnancy. Response options were: 'I feel very
45 supported', 'I feel supported most of the time', 'I feel supported sometimes' and 'I don't feel
46 supported at all'. For the intentions measure, participants were asked to indicate the extent to
47 which they agreed with the statement 'I plan to manage my gestational diabetes by following
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6 the advice I have been given at the clinic'. For the self-efficacy measure, participants were
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8 asked to indicate whether they agreed with the statement 'I feel confident that I can manage
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10 my gestational diabetes'. Response options to questions regarding intentions and self-efficacy
11
12 were: 'strongly disagree', 'somewhat disagree', 'neutral', 'somewhat agree', 'strongly agree'.

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14 Responses were scored on a scale of -2 to $+2$ with higher scores representing higher levels of
15
16 confidence.

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18 Information regarding the participants' age, BMI, postcode and history of previous
19
20 pregnancies was obtained from their medical records. Postcodes were used as an index of
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22 socio-economic status (SES) as defined by the Scottish Index of Multiple Deprivation (SIMD)
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24 [19]. SES categories range from 1 to 5 with 1 representing the highest level of deprivation.

25
26 All participants attended a ~~blood~~blood glucose monitoring demonstration with a
27
28 diabetes specialist nurse (~~1~~1 week following diagnosis); at this demonstration, ~~participants~~
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30 women were given guidance regarding diet, glucose monitoring and medication (if
31
32 applicable). All participants received the same guidance regarding GDM management. The
33
34 ~~follow~~follow-up telephone questionnaire was designed to assess the participants' level of
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36 concordance with these instructions over the past month. Questions were adapted from the
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38 Diabetes Compliance Questionnaire [14]. Participants were asked how frequently (always,
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40 mostly, sometimes or never) they followed three specific sets of behaviours; keeping to their
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42 overall diet plan, eating foods they should avoid and following instructions regarding glucose
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44 monitoring. Those who were prescribed metformin or insulin therapy were additionally asked
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46 to report how frequently (always, mostly, sometimes or never) they followed instructions
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48 regarding their medication and how frequently they had forgotten or chosen not to take their
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50 medication. Responses to each of these questions were scored on a scale of 0 to 3. An overall
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52 concordance score was calculated by summing scores for each question, these scores were
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54 then transformed to a scale ranging from ~~(0 to 10)~~0 to 10 using the formula: raw score/theoretical
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6 maximum $\times 10$. This approach allowed us to create comparable concordance scores for
7 participants treated with diet alone and participants that were prescribed medication.
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10 <H2>Statistical analysis

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13 Firstly, we reported how participants responded to the baseline questionnaire in terms of the
14 number and percentage of participants in each response category. Next, we ran a Spearman's
15 rank correlation test to examine associations among the variables measured at the first
16 interview. Finally, to test for associations between these variables and concordance score, we
17 ran two linear regression models with concordance score as the outcome variable. In the first
18 model, we entered affective response, risk perception, identity salience, intention, self-
19 efficacy and social support. In the second model, ~~in order~~ to test whether levels of
20 concordance also varied as a function of demographic differences, we additionally adjusted
21 for age, smoking status, whether it was the participant's first pregnancy, BMI and SIMD. All
22 analyses were conducted using IBM SPSS Statistics ~~Version-version~~ 22.0 [20].
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32 <H1>Results

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35 Of the 59 participants ~~we~~ recruited, ~~9-nine~~ were not contactable for the ~~follow-follow-up~~
36 interview. Of the 50 participants contacted at ~~1-1~~-month follow-up, 27 managed their GDM
37 with diet alone, 19 were prescribed ~~Metformin-metformin~~ and ~~4-four~~ were prescribed insulin.
38 The characteristics of the sample stratified by tertile of concordance score, ~~are displayed~~
39 ~~given~~ in ~~Table 1~~.
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45 One week following diagnosis of GDM, 36 participants (72%) reported an increase in
46 negative affect and anxiety. However, the magnitude of this change was small, the mean
47 score for affective response was ~~-4.7~~ (~~SD-SD~~ = 9.2); possible scores ranged between ~~-36~~
48 and +36. In response to questions regarding the risk of complications, 42 participants (84%)
49 believed there would be a low to moderate risk of complications if their glucose levels were
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6 controlled. In the case of uncontrolled glucose levels, 38 participants (76%) believed that
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8 their risk of complications would be quite high or very high (10 believed there would be a
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10 moderate risk and ~~1-one~~ that there would be a low risk). Most participants (~~49-out-of-of~~ 50)
11
12 reported their identity as '~~mother-'mother to be'-be'~~ as either very important or quite
13
14 important. In response to the question regarding social support, 40 participants (80%)
15
16 reported feeling very supported, ~~7-seven~~ (14%) felt supported most of the time and ~~3-three~~
17
18 (6%) felt supported sometimes. ~~Some~~ 46 participants (92%) expressed an intention to follow
19
20 guidelines regarding glucose control and 47 participants (94%) felt confident they would be
21
22 able to follow these guidelines. At follow-up, most participants reported high levels of
23
24 concordance with GDM management guidelines: 43 (86%) participants reported always or
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26 mostly following their diet plan, 49 participants (98%) reported always or mostly checking
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28 their blood sugar as recommended and 30 (81%) participants reported that they never or
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30 sometimes ate food that should be avoided. The mean concordance score in this ~~sample-group~~
31
32 was 14.2 (~~SD-SD~~ = 4.3).

33 Participant responses to the base-line and follow-up questionnaires are ~~displayed-given~~ in
34
35 Tables S1 and ~~2-2,~~ respectively.

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37 We tested for associations between these independent variables. ~~Table 2 displays-gives~~ a
38
39 summary of the results. It should be noted that following a Bonferroni correction for multiple
40
41 comparisons [21], only the correlation between risk perception and intention was statistically
42
43 significant. This significant correlation indicates that participants who perceived ~~that~~ the risk
44
45 of complications as high, ~~-~~ were more likely to express a strong intention to follow guidelines
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47 regarding glycaemic control during pregnancy.

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49 Results from the linear regression analysis predicting concordance are displayed in ~~Table 3,~~
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51 Significant predictors of concordance in model 1 were risk perception and social support. ~~A~~

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standard deviation (~~SD~~^{SD}) increase in risk perception score was associated with a 0.42 ~~SD~~^{SD} increase in concordance score ($P = 0.03$); a ~~SD~~^{SD} increase in social support score was associated a 0.36 ~~SD~~^{SD} increase in concordance score ($P = 0.02$). This model accounted for 13% of the variance in concordance scores ($R^2 = 0.13$). The second model additionally included age, BMI, smoking status, SES and whether it was a first-time pregnancy; in this model, the association between risk perception and concordance was attenuated ($0.38, P = 0.06$); however, the association between social support and concordance remained significant ($P = 0.01$). The adjusted R^2 for this model was 0.18.

<H1>Discussion

The aim of our study was to describe the psychosocial consequences of a GDM diagnosis using the teachable moment framework. Our results indicate that diagnosis of GDM is ~~characterised~~^{characterized} by an increase in negative affect and risk ~~perception~~^{perception}, and coincides with the adoption of a highly valued identity of mother to be. These findings provide support for the idea that diagnosis of GDM presents a ‘teachable moment’—; in other words, diagnosis is likely to motivate an increase in ~~health~~^{health}-protective behaviours. A further aim of our study was to test whether the factors outlined in the teachable moment model (affective response, risk perception and identity), as well as self-efficacy and social support, were predictive of concordance with GDM treatment during pregnancy. Risk perception and social support were the only factors associated with concordance in our sample.

Our findings regarding psychosocial changes following diagnosis build on those reported by previous studies. Qualitative studies have documented the emotional experiences of women diagnosed with GDM; many women report initial feelings of shock, fear and anxiety followed by a movement towards acceptance as the pregnancy progresses [8,22–24].

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6 However, few studies have investigated the experience of women diagnosed with GDM in
7 the United Kingdom (UK). The experience of British women may be distinct, ~~as~~ because, in
8 contrast with many other high-income countries, ~~where~~ all women are screened for GDM at
9 24-24 weeks of pregnancy, women in the United KingdomUK are only screened if they are
10 identified as being at risk (i.e. having a BMI over 30, a history of GDM or a family history of
11 diabetes) [25]. Daniells *et al.* [26] argues that selective screening may cause women to feel
12 greater distress because they are singled out as being 'high risk'. One week following
13 diagnosis, most participants in our study reported a moderate increase in negative affect,
14 suggesting that diagnosis under a selective screening system may not cause additional
15 distress. However, further qualitative work with British women, particularly focusing on the
16 time of diagnosis, would provide further insight regarding the emotional consequences of
17 selective screening for GDM.

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29 Research into risk perception among women diagnosed with GDM remains scarce. One study
30 examined this topic from the perspective of health-care practitioners [27]. According to this
31 previous study, many women with GDM are unaware of the risks associated with a GDM
32 pregnancy. In contrast with these previous findings, partieipants-women in our study held
33 accurate views regarding the risk of experiencing perinatal complications. Risk of
34 complications among women with GDM is higher than in the general population [28] and is
35 increased further if glucose levels are not controlled [29].

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43 Our results regarding identity highlight that diagnosis coincides with the adoption of a highly
44 valued maternal identity. A number of authors have suggested that adoption of this identity
45 qualifies pregnancy as an important 'teachable moment' [11,30]. While a maternal identity is
46 likely to play a central role in the processes of psychological adaptation during the period of
47 GDM diagnosis, the experience of diagnosis itself may also mark the adoption of an 'ill
48 health' identity [31]. More detailed measurement of change in identity during pregnancy, and
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6 the relationship between a maternal and an ill health identity as prompted by a diagnosis of
7 GDM warrants further investigation.

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10 Our finding that higher risk perception was associated with greater concordance is in line
11 with health behaviour theory [32–34]. However, in our [sample study](#), following adjustment
12 for demographic factors, BMI and smoking status, the association between risk perception
13 and concordance score was non-significant ($P = 0.06$). Raising awareness of the risks
14 associated with a GDM pregnancy might encourage concordance with GDM management
15 advice; however, such an approach should be adopted cautiously, as increasing risk
16 perception can have unintended consequences. Previous work illustrates that heightened risk
17 perception in combination with anxiety or worry can cause individuals to develop fatalistic
18 beliefs about their health, and to disengage from [health-protective behaviours](#)
19 [health-protective behaviours](#) [35]. The interaction between negative affect and risk perception may be
20 particularly relevant in cases when women with GDM are prescribed glucose-lowering
21 medication. In a qualitative study with 19 participants, Draffin *et al.* [36] found that women
22 reported an increase in risk perception and anxiety in response to the prescription of insulin.
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35 Social support was the strongest predictor of concordance in our sample. This finding is in
36 line with results reported in a previous cross-sectional quantitative study ($n = 98$), in which
37 higher social support was significantly associated with greater (self-reported) concordance
38 with instructions regarding diet and (insulin) medication [11]. Our findings are also in
39 accordance with a recent qualitative study into the enablers and barriers to achieving good
40 glycaemic control during a GDM pregnancy. Women with GDM in this latter study reported
41 that support from partners, family, friends and others, was key to achieving good glycaemic
42 control [23]. Support [programmes](#) for women with GDM may benefit from placing a greater
43 emphasis on the role and support provided by significant others. Future studies could also
44 explore the potential relationship between social support and risk perception. For instance,
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6 women with a family history of GDM may have additional insight regarding the potential
7 risks associated with the condition, and, also receive greater support from family members.
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10 In our study, negative affect and self-efficacy were not related to concordance at ~~follow~~
11 follow-up. However, these factors should not be discounted. Previous qualitative work has
12 documented women's experiences of anxiety and fear following GDM diagnosis and how
13 such negative emotional responses, particularly in combination with feelings of low self-
14 efficacy, can result in defence responses ~~which that~~ negatively impact GDM management
15 [37]. In addition, other quantitative studies have reported an association between self-
16 efficacy, depression and self-management in the case of ~~type~~ Type 1 and 2 diabetes [38,39].
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19 It is possible that our sample size was not large enough to detect these associations. Identity
20 salience was also not related to concordance in our study. Assessing the effect of this variable
21 was problematic in our study due to low response variability – that is, all women in our
22 ~~sample study prioritised~~ prioritized the identity of 'mother to be'. Items regarding self-
23 efficacy and intentions also suffered from ceiling effects, which may have limited our chance
24 of detecting associations between these variables and levels of concordance.
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35 An important limitation of our study is the small sample size. Because of this, our study was
36 underpowered to detect small to medium effect sizes; replication of our study in a larger
37 sample may reveal associations between concordance and additional psychosocial factors in
38 the ~~Teachable~~ 'teachable Moments-moments' model. A second limitation of our study is that
39 concordance was assessed using a self-reported measure. This measure was likely subject to a
40 certain degree of self-report bias: participants may have over-reported their level of
41 concordance [40]. It would have been preferred to assess actual (observed) concordance
42 rather than rely on self-report or intention, although this is more complex, costly and difficult
43 to achieve. A further limitation is the use of mainly single-item, non-validated measures in
44 this study. This reflected the exploratory nature of the work, and the pragmatic nature of
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6 carrying out the study in an [National Health Service \(NHS-NHS\)](#) clinical context. The study
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8 could be repeated using validated measures of the main study constructs. The different
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10 methods of administration for the baseline and follow-up questionnaires is an additional
11
12 limitation; at baseline, participants self-completed a pen and paper questionnaire, whereas at
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14 follow-up, participant responses were recorded via a brief telephone interview. This approach
15
16 was chosen to ~~maximise~~ [maximize](#) participant retention at follow-up. However, it is possible
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18 that participants were less willing to report actual levels of concordance over the phone.
19
20 Finally, we did not record information regarding participants' level of education, or ethnicity.
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22 These additional factors may be related to GDM self-management, and should be considered
23
24 in future studies.

25
26 In summary, our results support the idea that GDM diagnosis provides a 'teachable moment'.
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28 Interventions designed to improve glycaemic control during pregnancy may benefit from a
29
30 focus on risk perception, self-efficacy and social support.
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34 **Funding sources**

35
36 None.

37 **Competing interests**

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39 None declared.
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45 **References**

- 46
47 1 Anna V, van der Ploeg HP, Cheung NW, Huxley RR, Bauman AE. Sociodemographic
48 correlates of the increasing trend in prevalence of gestational diabetes mellitus in a large
49 population of women between 1995 and 2005. *Diabetes Care* 2008; 31: 2288–2293.
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6 2 Farrar D *et al.* Prevalence of gestational diabetes in the UK and Republic of Ireland: a
7 systematic review. XXX 2016; X: xx-xx.
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10 3 Mitanchez D, Burguet A, Simeoni U. Infants born to mothers with gestational diabetes
11 mellitus: mild neonatal effects, a long-term threat to global health. *J Pediatr* 2014; **164**:
12 445–450.
13
14
15 4 Ovesen PG, Jensen DM, Damm P, Rasmussen S, Kesmodel US. Maternal and neonatal
16 outcomes in pregnancies complicated by gestational diabetes. A nation-wide study. *J*
17 *Matern Fetal Neonatal Med* 2015; **28**: 1720–1724.
18
19
20 5 Bellamy L, Casas J-P, Hingorani AD, Williams D. Type 2 diabetes mellitus after
21 gestational diabetes: a systematic review and meta-analysis. *Lancet* 2009; **373**: 1773–
22 1779.
23
24
25 6 Song C, Lyu Y, Li C, Liu P, Li J, Ma RC *et al.* Long-term risk of diabetes in women at
26 varying durations after gestational diabetes: a systematic review and meta-analysis with
27 more than 2 million women. *Obes Rev* 2018; **19**: 421–429.
28
29
30 7 Tam WH, Ma RC, Yang X, Li AM, Ko GT, Kong AP *et al.* Glucose intolerance and
31 cardiometabolic risk in adolescents exposed to maternal gestational diabetes: a 15-year
32 follow-up study. *Diabetes Care* 2010; **33**: 1382–1384.
33
34
35 8 Persson M, Winkvist A, Mogren I. ‘From stun to gradual balance’—women’s
36 experiences of living with gestational diabetes mellitus. *Scand J Caring Sci* 2010; **24**:
37 454–462.
38
39
40 9 Ghaffari F, Salsali M, Rahnavard Z, Parvizy S. Compliance with treatment regimen in
41 women with gestational diabetes: living with fear. *Iran J Nurs Midwifery Res* 2014;
42 **19(Suppl 1)**: S103.
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- 10 Nielsen KK, Kapur A, Damm P, De Courten M, Bygbjerg IC. From screening to postpartum follow-up—the determinants and barriers for gestational diabetes mellitus (GDM) services, a systematic review. *BMC Pregnancy Childbirth* 2014; **14**: 1.
 - 11 McBride CM, Emmons KM, Lipkus IM. Understanding the potential of teachable moments: the case of smoking cessation. *Health Educ Res* 2003; **18**: 156–170.
 - 12 Gonzalez JS, Kane NS, Binko DH, Shapira A, Hoogendoorn CH. Tangled up in blue: unraveling the links between emotional distress and treatment adherence in type 2 diabetes. *Diabetes Care* 2016; **39**: 2182–2189.
 - 13 Gaston A, Cramp A, Prapavessis H. Enhancing self-efficacy and exercise readiness in pregnant women. *Psychol Sport Exerc* 2012; **13**: 550–557.
 - 14 Ruggiero L, Spirito A, Bond A, Coustan D, McGarvey S. Impact of social support and stress on compliance in women with gestational diabetes. *Diabetes Care* 1990; **13**: 441–443.
 - 15 MacLeod C, Hagan R. Individual differences in the selective processing of threatening information, and emotional responses to a stressful life event. *Behav Res Ther* 1992; **30**: 151–161.
 - 16 Tavakol M, Dennick R. Making sense of Cronbach’s alpha. *Int J Med Educ* 2011; **2**: 53.
 - 17 Heaman MI, Gupton AL. Psychometric testing of the ~~perception~~ Perception of pregnancy ~~Pregnancy risk~~ Risk questionnaire Questionnaire. *Res Nurs Health* 2009; **32**: 493–503.
 - 18 Touliatos J, Perlmutter BF, Straus MA. *Handbook of Family Measurement Techniques: Abstracts*, Vol. 1. Thousand Oaks, CA: SAGE, 2001.
 - 19 Scottish Government. *Scottish Index of Multiple Deprivation*. Available: <http://www.gov.scot/Topics/Statistics/SIMD> Last accessed: 2 March 2017.
 - 20 *IBM SPSS Statistics for Windows*. Armonk, NY: IBM ~~Corp.~~, 2013.

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2
3
4
5
6 21 Abdi H. Bonferroni and Šidák corrections for multiple comparisons. *Encycl Meas Stat*
7 2007; **3**: 103–107.
8
9
10 22 Kaptein S, Evans M, McTavish S, Banerjee AT, Feig DS, Lowe J *et al*. The subjective
11 impact of a diagnosis of gestational diabetes among ethnically diverse pregnant women:
12 a qualitative study. *Can J Diabetes* 2015; **39**: 117–122.
13
14
15 23 Martis R, Brown J, McAra-Couper J, Crowther CA. Enablers and barriers for women
16 with gestational diabetes mellitus to achieve optimal glycaemic control—a qualitative
17 study using the theoretical domains framework. *BMC Pregnancy Childbirth* 2018; **18**:
18 91.
19
20
21 24 Morrison MK, Lowe JM, Collins CE. Australian women’s experiences of living with
22 gestational diabetes. *Women Birth* 2014; **27**: 52–57.
23
24
25 25 Utz B, Kolsteren P, De Brouwere V. Screening for gestational diabetes mellitus: are
26 guidelines from high-income settings applicable to poorer countries? *Clin Diabetes*
27 2015; **33**: 152–158.
28
29
30 26 Daniells S, Grenyer BFS, Davis WS, Coleman JK, Burgess J-AP, Moses RG.
31 Gestational diabetes mellitus: is a diagnosis associated with an increase in maternal
32 anxiety and stress in the short and intermediate term? *Diabetes Care* 2003; **26**: 385–389.
33
34
35 27 Mersereau P, Williams J, Collier SA, Mulholland C, Turay K, Prue C. Barriers to
36 managing diabetes during pregnancy: the perceptions of health care practitioners. *Birth*
37 2011; **38**: 142–149.
38
39
40 28 Bener A, Saleh NM, Al-Hamaq A. Prevalence of gestational diabetes and associated
41 maternal and neonatal complications in a fast-developing community: global
42 comparisons. *Int J Womens Health* 2011; **3**: 367–373.
43
44
45 29 Kim C. Gestational diabetes: risks, management, and treatment options. *Int J Womens*
46 *Health* 2010; **2**: 339–351.
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- 30 Phelan S. Pregnancy: a ‘teachable moment’ for weight control and obesity prevention. *Am J Obstet Gynecol* 2010; **202**: 135-e1.
- 31 Feig DS, Chen E, Naylor CD. Self-perceived health status of women three to five years after the diagnosis of gestational diabetes: a survey of cases and matched controls. *Am J Obstet Gynecol* 1998; **178**: 386–393.
- 32 Becker MH. The health belief model and sick role behaviour. *Health Educ Monogr* 1974; **2**: 409–419.
- 33 Rogers RW. A protection motivation theory of fear appeals and attitude change. *J Psychol* 1975; **91**: 93–114.
- 34 Weinstein ND. The precaution adoption process. *Health Psychol* 1988; **7**: 355.
- 35 Portnoy DB, Ferrer RA, Bergman HE, Klein WM. Changing deliberative and affective responses to health risk: a meta-analysis. *Health Psychol Rev* 2014; **8**: 296–318.
- 36 Draffin CR, Alerdice FA, McCance DR, Maresh M, Harper R, McSorley O *et al.* Exploring the needs, concerns and knowledge of women diagnosed with gestational diabetes: a qualitative study. *Midwifery* 2016; **40**: 141–147.
- 37 Parsons J, Ismail K, Amiel S, Forbes A. Perceptions among women with gestational diabetes. *Qual Health Res* 2014; **24**: 575–585.
- 38 Sarkar U, Fisher L, Schillinger D. Is self-efficacy associated with diabetes self-management across race/ethnicity and health literacy? *Diabetes Care* 2006; **29**: 823–829.
- 39 Gonzalez JS, Peyrot M, McCarl LA, Collins EM, Serpa L, Mimiaga MJ *et al.* Depression and diabetes treatment nonadherence: a meta-analysis. *Diabetes Care* 2008; **31**: 2398–2403.
- 40 Adams AS, Soumerai SB, Lomas J, Ross-Degnan D. Evidence of self-report bias in assessing adherence to guidelines. *Int J Qual Health Care* 1999; **11**: 187–192.

<H1>Appendix**<H2>Baseline questionnaire***1. Emotional impact*

These questions are about how you have been feeling since being told you have gestational diabetes. Please circle the number on each scale that best represents how your mood has been since being told. An example question is given below to explain how to answer these questions. So, for example, if you think you are worrying slightly more than usual you would circle -2 as shown.

Example question:

Have you found yourself worrying more or less than usual?

-6	-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	+6
much	moderately	slightly			no		slightly		moderately			much
more	more	more			difference		less		less			less

Questions:

Have you experienced higher or lower levels of anxiety than is normal for you in pregnancy?

-6	-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	+6
much	moderately	slightly			no		slightly		moderately			much
higher	higher	higher			difference		lower		lower			lower

Has your ability to relax been better or worse?

-6	-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	+6
much	moderately	slightly			no		slightly		moderately			much
worse	worse	worse			difference		better		better			better

Have you become more or less tense?

-6	-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	+6
much	moderately	slightly			no		slightly		moderately			much
more	more	more			difference		less		less			less

Have you been feeling more or less unhappy than usual?

-6	-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	+6
much	moderately	slightly			no		slightly		moderately			much
more	more	more			difference		less		less			less

Has the quality of your sleep been better or worse?

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-6	-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	+6
much worse	moderately worse		slightly worse		no difference		slightly better		moderately better		much better	

10 Have you been enjoying your life more or less?

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-6	-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	+6
much less	moderately less		slightly less		no difference		slightly more		moderately more		much more	

18 *2. Risk perception*

19 When blood sugar is not controlled in gestational diabetes the risk of birth complications (such as
20 needing to induce labour or the baby having low blood sugar) can increase. The next questions are
21 about how you think about this risk. There are no right or wrong answers we are only interested in
22 your opinion.

23 Thinking about the plans you have to control your blood sugar, how high do you think the risk will be
24 for you during this pregnancy? Please tick the box that gives the best answer for you.

25
26
27 very high risk quite high risk medium risk quite low risk no risk at all

28
29
30 Thinking about the plans you have to control your blood sugar, how high do you think the risk will be
31 for your baby during this pregnancy? Please tick the box that gives the best answer for you.

32
33
34 very high risk quite high risk medium risk quite low risk no risk at all

35
36
37
38 How high do you think the risk for you during this pregnancy would be if your blood sugar
39 was **not controlled**? Please tick the box that gives the best answer for you.

40
41
42 very high risk quite high risk medium risk quite low risk no risk at all

43
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47 How high do you think the risk for your baby would be if your blood sugar was **not**
48 **controlled**? Please tick the box that gives the best answer for you.

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51 very high risk quite high risk medium risk quite low risk no risk at all

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8 **3. Identity**

9 Think of who you are as a person, and the many identities (for example, friend, worker, sister,
10 neighbour, mother) that make up who you are, yourself. How important to you is your identity as
11 'mother to be' at this point in your life? Please tick the box that gives the best answer for you.

12
13
14 very important quite important not very important not important at all
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16
17 Thinking about your identity as 'mother to be' what responsibilities do you feel you have during
18 pregnancy? There is no right or wrong answer we are just interested in your opinion (please provide
19 details below).

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31 Do you feel that your family/friends support you in fulfilling these responsibilities? Please tick the
32 box that gives the best answer for you.

33
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35 I feel very supported I feel supported most I feel supported I don't feel
36 supported of the time sometimes supported at all
37
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40 **4. Intentions**

41 Please tick the box that gives the best answer for you.

42
43 I plan to manage my gestational diabetes by following the advice I have been given at the clinic

44
45
46 strongly somewhat neutral somewhat strongly
47 disagree disagree agree agree
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50 I feel confident that I can manage my gestational diabetes

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strongly disagree somewhat disagree neutral somewhat agree strongly agree

<H2>Follow-up questionnaire

One month follow-up questionnaire: concordance with diet and medication plan (telephone interview)

I am going to ask you a few quick questions about how you have been managing your gestational diabetes over the past month.

1. What treatment are you currently receiving?
Diet alone Oral medication (metformin) Insulin therapy
2. In the past month have you followed the diet plan prescribed by the Dietician?
Always Mostly Sometimes Never
3. In the past month have you eaten foods that you should avoid on your diet?
Always Mostly Sometimes Never
4. In the past month have you checked your blood sugar as often as recommended by the diabetes nurse?
Always Mostly Sometimes Never
5. *Do you take metformin/insulin injections as prescribed by the diabetes nurse?
Always Mostly Sometimes Never
6. *In the past month have you forgotten to take or skipped your diabetes medication?
Always Mostly Sometimes Never

*Questions for women receiving oral medication or insulin therapy only.

<H1>Supporting Information

Additional Supporting Information may be found in the online version of this article:

Table S1. Participant responses to the baseline questionnaire.

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Table 2. Participant responses to the follow-up questionnaire.

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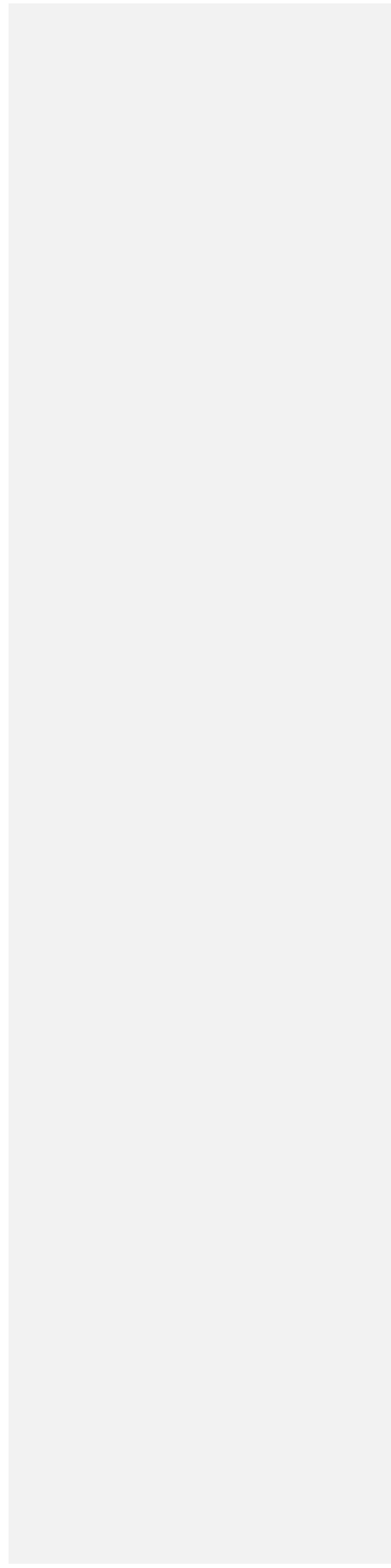


Table 1. Characteristics of women 1 week after diagnosis with gestational diabetes stratified according to tertile of concordance (for gestational diabetes recommended treatment), which was assessed 1 month later ($n = 50$)

Characteristic	Low	Middle	High
<i>N</i>	19 (38)	13 (26)	18 (36)
Concordance score	7.36 (0.29)	8.28 (0.13)	9.20 (0.58)
Minimum and maximum	6.67–7.50	8.00–8.33	8.50–10.00
Age	31.8 (6.4)	32.3 (4.9)	31.4 (6.0)
BMI	32.3 (6.8)	33.2 (8.0)	36.8 (9.2)
Current smoker*	1 (5)	1 (8)	0 (0)
First pregnancy*	12 (63)	7 (54)	7 (39)
No glucose-lowering medication*	13 (68)	9 (69)	5 (28)
SIMD score*			
1 or 2	11 (58)	9 (69)	16 (89)
3	4 (21)	2 (15)	2 (11)
4 or 5	2 (11)	2 (15)	0 (0)

Data are shown as mean (SD) or * n (%). For concordance score, we additionally show minimum and maximum scores within each tertile. SIMD, Scottish Index of Multiple Deprivation.

Table 2. Spearman correlation coefficients between characteristics of the women one week after diagnosis with gestational diabetes

	Affective Response	Risk Perception	Identity Salience	Intention	Self-efficacy
Affective Response					
Risk Perception	-0.30* (0.025)				
Identity Salience	0.21 (0.361)	0.01 (0.937)			
Intention	-0.02 (0.876)	0.48** (0.001)	0.21 (0.145)		
Self-efficacy	0.32* (0.025)	-0.24 (0.098)	0.14 (0.350)	0.32* (0.024)	
Social Support	0.29* (0.038)	-0.07 (0.660)	0.20 (0.162)	-0.07 (0.650)	-0.07 (.648)

Exact *P*-values are shown in parentheses.

*Correlation significant at the 0.05 level (two-tailed).

**Correlation significant at the 0.01 level (two-tailed).

Table 3. Regression models showing associations between baseline measures and concordance score at 1 month follow-up

	Univariate analysis	<i>P</i> -value	Model 1	<i>P</i> -value	Model 2	<i>P</i> -value
	<i>B</i> (SE <i>B</i>)		adj. $R^2 = 0.13$		$R^2 = 0.18$	
			<i>B</i> (SE <i>B</i>)		<i>B</i> (SE <i>B</i>)	
Affective Response	0.01 (0.01)	0.46	0.02 (0.02)	0.29	0.02 (0.02)	0.35
Risk Perception	0.10 (0.06)	0.09	0.18 (0.08)	0.03	0.16 (0.08)	0.06
Identity Salience	0.21 (0.24)	0.37	-0.02 (0.27)	0.94	0.03 (0.28)	0.92

1							
2							
3	Social Support	0.64 (0.21)	0.01	0.68 (0.28)	0.02	0.79 (0.30)	0.01
4	Intention	-0.01 (0.13)	0.91	-0.16 (0.16)	0.35	-0.22 (0.18)	0.24
5							
6	Self-efficacy	-0.02 (0.16)	0.90	0.08 (0.22)	0.72	0.15 (0.22)	0.51
7							

8 Model 1, multivariate analysis with all six baseline measures; model 2, multivariate analysis, additionally
9 adjusted for age, first pregnancy, BMI and SIMD score.

10 *B*, parameter estimate; SE *B*, standard error of the parameter estimate; SIMD, Scottish Index of Multiple
11 Deprivation.
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For Peer Review

Supporting Information

Diagnosis of Gestational Diabetes: a 'Teachable Moment'

J. Okely,¹ C. Mason,¹ A. Collier,² N. Dunnachie² and V. Swanson¹

¹ Psychology Division, University of Stirling, Stirling, UK

² University Hospital Ayr, Ayr, UK

Table S1. Participant responses to the baseline questionnaire

Item	N (%)
Negative affect,	
Increase	36 (61)
No change	16 (27)
Decrease	7 (12)
Anxiety	
Increase	43 (73)
No change	10 (17)
Decrease	6 (10)
Risk Perception	
Controlled	
Own	
Low/moderate risk	52 (90)
Quite/very high risk	6 (10)
Baby's	

1		
2		
3	Low/moderate risk	51 (90)
4		
5	Quite/very high risk	6 (11)
6		
7	Uncontrolled	
8		
9	Own	
10		
11	Low/moderate risk	14 (24)
12		
13	Quite/very high risk	44 (75)
14		
15		
16	Baby's	
17		
18	Low/moderate risk	11 (19)
19		
20	Quite/very high risk	47 (81)
21		
22	Identity Salience	
23		
24	Very important	36 (61)
25		
26	Quite important	22 (37)
27		
28	Not very important	1 (2)
29		
30	Not important	0
31		
32		
33	Intention	
34		
35	Strongly agree	50 (85)
36		
37	Somewhat agree	3 (5)
38		
39	Neutral	6 (10)
40		
41	Disagree	5 (9)
42		
43		
44	Self-efficacy	
45		
46	Strongly agree	40 (68)
47		
48	Somewhat agree	14 (24)
49		
50	Neutral	1 (2)
51		
52	Disagree	5 (9)
53		
54		
55	Social Support	
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Very support	45 (76)
Mostly supported	10 (17)
Sometimes supported	4 (7)
Never supported	0

Table 2. Participant responses to the follow-up questionnaire

Item	N (%)
GDM treatment,	
Diet alone	27 (46)
Oral medication	19 (32)
Insulin therapy	4 (7)
Followed diet plan	
Always	12 (24)
Mostly	31 (62)
Sometimes	6 (12)
Never	1 (2)
Eaten foods that should be avoided	
Always	1 (3)
Mostly	6 (16)
Sometimes	27 (73)
Never	3 (8)
Checked blood sugar as recommended	
Always	32 (64)
Mostly	17 (34)

1		
2		
3	Sometimes	1 (2)
4		
5	Never	0
6		
7	Metformin/insulin injections as directed	
8		
9	Always	20 (87)
10		
11	Mostly	2 (9)
12		
13	Sometimes	1 (4)
14		
15	Never	0
16		
17		
18	Forgotten/skipped GDM medication	
19		
20	Always	1 (6)
21		
22	Mostly	1 (6)
23		
24	Sometimes	4 (24)
25		
26	Never	11 (65)
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