

# Self-management among type 2 diabetes patients via the WeChat application: A systematic review and meta-analysis

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## Abstract

**What is known and objective:** The incidence of diabetes has been rising worldwide and is expected to increase to affect 591.9 million people by 2035 in China. Strict control of blood glucose can significantly reduce the risk of diabetic complications, but traditional interventions lack continuity, timeliness and teleonomy. The development of mobile health management has become a hot topic, as a very popular app in China, WeChat platform, has a large number of users every day. Many studies show the health management of patients with diabetes through WeChat can achieve the ideal effect. This study aims to evaluate the application of WeChat based on clinical research data, provide clinical evidence for medical staff and promote the self-management of patients with diabetes.

**Methods:** The PubMed, EMBASE, Cochrane Library, CNKI and Wanfang database were searched to identify related reports that were published up to 9 March 2020. The quality of included studies was assessed by Cochrane Collaboration risk assessment tool. Measures of interest were mean difference (MD) and 95% confidence interval (CI). Random-effect model was used according to the absence or presence of significant heterogeneity. Heterogeneity among trials was evaluated by  $I^2$  test. Publication bias was assessed by funnel plots.

**Results and discussion:** Thirty-eight articles involved 2,709 controls and 2,709 patients who used WeChat were identified. Relative to the traditional group, WeChat group had a lower level in fasting plasma glucose (FPG in mmol/L; MD: 1.36, 95% CI 1.10-1.62,  $P < .00001$ ), so did 2hPG (MD: 1.91, 95% CI 1.48-2.35,  $P < .00001$ ) and HbA1C (MD: 1.07, 95% CI 0.86-1.27,  $P < .00001$ ). Self-efficacy scale improved significantly, including diet score (MD: -1.31, 95% CI -1.77 to -0.86,  $P < .00001$ ), exercise score (MD: -1.92, 95% CI -2.44 to -1.40,  $P < .00001$ ), medication taking score (MD: -1.45, 95% CI: -1.94 to -0.97,  $P < .00001$ ), monitoring of blood glucose score (MD: -1.17, 95% CI -1.83--0.51,  $P = .0005$ ) and foot care score (MD: -1.71, 95% CI -2.08 to -1.34,  $P < .00001$ ). Patients' understanding of the disease and satisfaction with follow-up increased significantly, whereas the incidence of adverse reactions and complications decreased.

**What is new and conclusion:** WeChat follow-up appears to be helpful to improve the level of blood glucose and self-management, reduce the incidence of adverse reactions and complications, and improve the satisfaction rate of patients with type

2 diabetes. It should be noted that this meta-analysis has limitations, such as small sample sizes and the low quality of included literature, as well as the lack of research in Western countries. Therefore, more high-quality studies with larger samples are needed in the future to verify our results.

#### KEYWORDS

meta-analysis, self-management, systematic review, type 2 diabetes, WeChat

## 1 | WHAT IS KNOWN AND OBJECTIVE

The incidence of diabetes has been rising worldwide. It has increased from 0.67% in 1980 to 10.4% in 2013 in China<sup>1</sup> and is expected to increase to 591.9 million by 2035.<sup>2</sup> Epidemiological studies in China show that<sup>3</sup> the direct medical expenses generated by diabetes increase rapidly, exceeding the gross domestic product (GDP) of the same period and one of the important reasons for its high economic burden is the complications of diabetes.<sup>4,5</sup> Some classic studies<sup>6,7</sup> have proved that strict control of blood glucose can significantly reduce the risk of diabetic complications, but traditional interventions lack continuity and timeliness, so the effect is generally not ideal.<sup>8</sup>

With the popularity of mobile phones, the development of mobile health management has become a hot subject. More than 90% of people in China use mobile phones, which brings convenience to the new health management model. As a very popular app in China, the WeChat platform has a large number of users every day. It can communicate at any time and any place through voices, pictures, videos and other forms, effectively solving the disadvantages of traditional interventions.

There are studies showing the health management of patients with diabetes through WeChat can achieve the ideal effect of controlling blood glucose, reduce complications and improve treatment compliance and satisfaction compared with conventional methods, but most of the research samples are small, and there are differences in the research objects. In addition, there is no systematic review and meta-analysis of the impact of WeChat on self-management of diabetes patients. Therefore, this study aims to evaluate the application of WeChat based on clinical research data, provide clinical evidence for medical staff and promote the self-management of diabetes patients.

## 2 | METHODS

### 2.1 | Search strategy

The articles published before 9 March 2020 were searched via PubMed, Cochrane Library, EMBASE, China National Knowledge Infrastructure (CNKI) and Wanfang database, systematically and independently searched by two authors. References of the retrieved articles were also reviewed and relevant studies were included.

Search terms included “WeChat”, “diabetes”, “blood glucose”, “blood sugar”, “weixin”, “tangniaobing” and “xuetang” (Table S1). No language restriction was applied to the search.

### 2.2 | Eligibility and exclusion criteria

Randomized controlled trials (RCTs) were included in the meta-analysis if they satisfied the following criteria: (a) type 2 diabetic patients who were  $\geq 18$  years old, (b) an intervention time at least 3 months, (c) a control group that received traditional follow-up and an experimental group add WeChat on this basis and (d) studies that evaluated at least one of the outcomes for the present study. The outcome was included fasting plasma glucose (FPG), 2-hour postprandial blood glucose (2hPG) and glycated haemoglobin (HbA1C). The units of FPG and 2hPG were mmol/L. The exclusion criteria were (a) repeated publication, (b) unable to get full text, (c) case reports or review articles and (d) special population such as children and pregnant women.

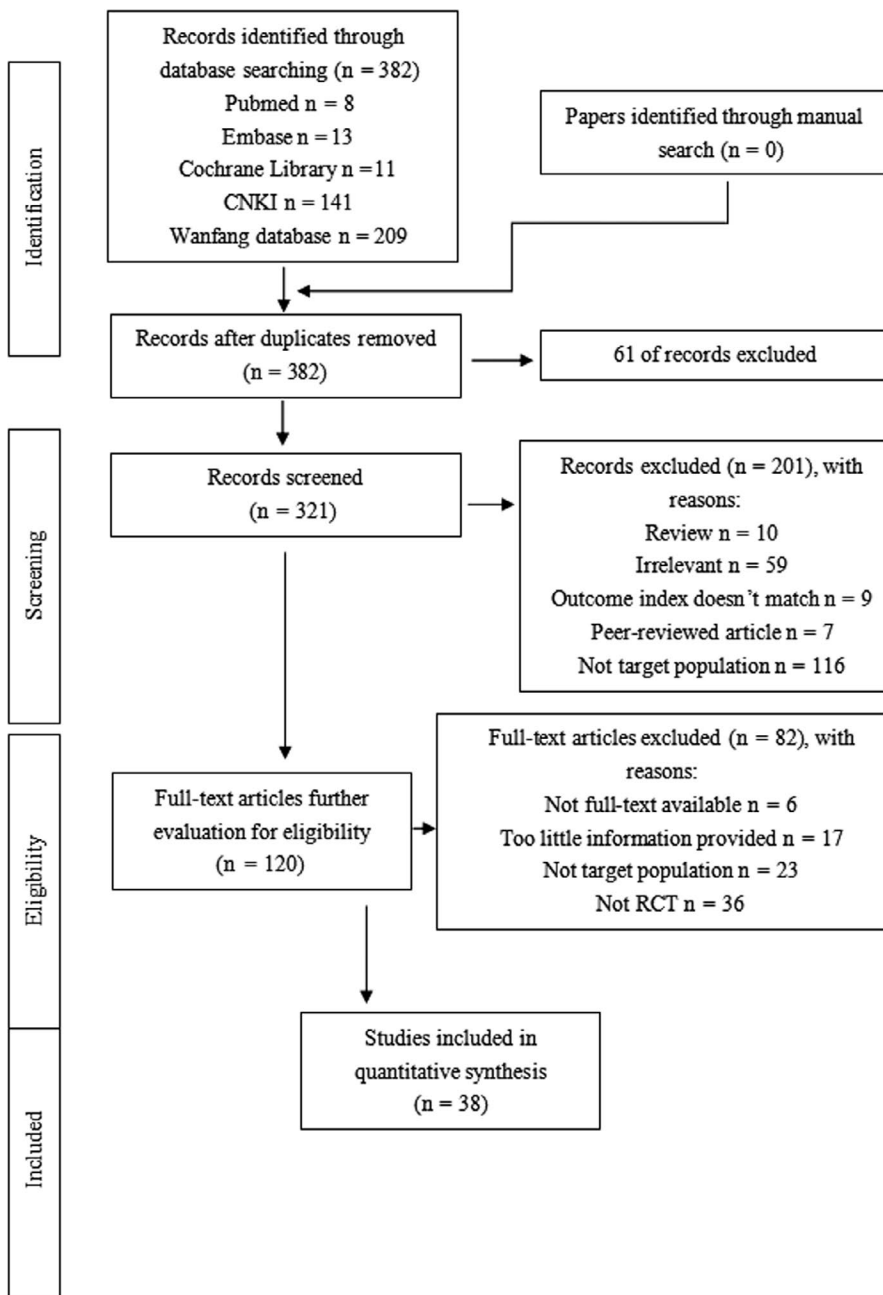
### 2.3 | Study selection process

This part was completed by two authors independently. Screened titles and abstracts identified by search process, two reviewers retrieved and reviewed all potentially eligible studies independently using previously mentioned inclusion criteria. A second screening was done via a full-text review by the reviewers. Any disagreement was resolved by the discussion and consensus of a third author, if applicable, was recorded to ensure a final consensus among the three reviewers.

### 2.4 | Data extraction

Two reviewers independently completed relevant information using a predesigned form that included characteristics of each study (eg, author, year of publication, country, research type, age, follow-up), patient population (numbers of traditional group and WeChat group) and clinical outcomes (eg, FPG, 2hPG, HbA1C and self-efficacy scales) of the two regimens in each study.

A third author checked the data and added additional relevant data. The three authors discussed and reached a unified result if there was any disagreement. If necessary, the fourth author could assist in the evaluation.



**FIGURE 1** Preferred reporting items for systematic reviews and meta-analyses flowchart depicting the study identification, screening, eligibility and inclusion process

## 2.5 | Self-efficacy scales

There were four main types of health scales used by patients: SDSCA measure,<sup>9</sup> SF-36 measure,<sup>10</sup> DMSES<sup>11</sup> and CN-ADDQOL measure.<sup>12</sup>

Summary of diabetes self-care activities (SDSCA) measure: This scale was developed in 2000 and was widely used abroad.<sup>13</sup> It was a self-reported questionnaire for diabetic patients' self-management, including 11 items of general diet, specific diet, exercise, blood glucose monitoring, foot care and smoking. These items used a 0-7 points scoring method, with a total questionnaire score of 0-77 points. The higher the score, the better the self-management behavior. The standardized scoring formula was (actual score/highest possible score)×100, ≤40 was bad, 41-80 was

medium, and >80 was good. The Cronbach's  $\alpha$  coefficient of each dimension was 0.62-0.92.

The Short Form-36 (SF-36) Health Survey measure<sup>14</sup>: It was used in clinical practice and research to measure the outcome associated with certain diseases. This scale included 8 items, physical function, role-physical, body pain, general health, vitality, society function, role emotional and mental health. Conversion score = (original score-lowest possible score) / (highest possible score-lowest possible score)×100, the result was 0-100 from bad to good.

Diabetes Management Self-Efficacy Scale (DMSES)<sup>15</sup>: The scale was divided into 20 items, each item was 0-10 points, and the total score was 0-200 points. The higher the score, the better the self-management. Final score = actual score of the scale/highest

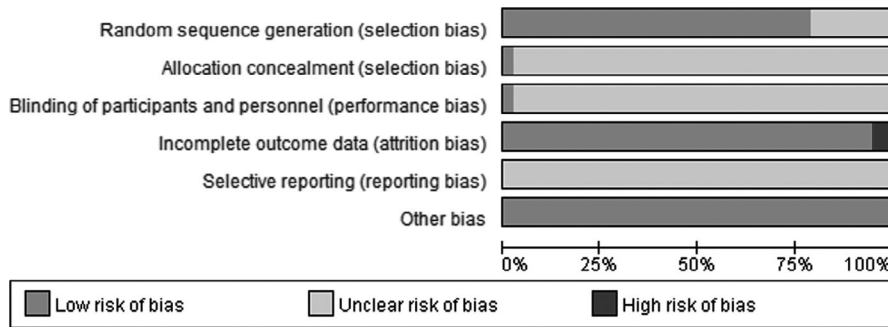
**TABLE 1** Extracted and analysed data of this systematic literature review

Author	Year	Type	Country	Sample Size (n)			Age	Follow-up time (m)
				Total	Traditional group	WeChat group		
Yang <sup>18</sup>	2015	RCT	China	102	51	51	22-71	6
Chen <sup>19</sup>	2015	RCT	China	60	30	30	20-50	6
Zeng <sup>20</sup>	2015	RCT	China	80	40	40	36-80	3
Liu <sup>21</sup>	2016	RCT	China	120	56	57	18-59	6
Wang <sup>22</sup>	2016	RCT	China	100	47	48	32-65	3
Luo <sup>23</sup>	2016	RCT	China	200	100	100	42-71	12
Zhan <sup>24</sup>	2017	RCT	China	120	60	60	20-60	12
Shi <sup>25</sup>	2017	RCT	China	158	80	78	23-50	6
Hu <sup>26</sup>	2017	RCT	China	120	60	60	22-44	6
Huang <sup>27</sup>	2017	RCT	China	86	41	42	18-59	6
Fu <sup>28</sup>	2017	RCT	China	100	50	50	18-60	6
Dai <sup>29</sup>	2017	RCT	China	100	50	50	35-72	6
Chen <sup>30</sup>	2017	RCT	China	80	37	40	60-75	6
Dong <sup>31</sup>	2017	RCT	China	123	59	60	45-60	12
Kang <sup>32</sup>	2017	RCT	China	200	100	100	45-67	6
Dong <sup>33</sup>	2018	RCT	China	120	59	60	23-60	12
Yuan <sup>34</sup>	2018	RCT	China	220	110	110	40-80	6
Ye <sup>35</sup>	2018	RCT	China	120	60	60	40-67	6
Huang <sup>36</sup>	2018	RCT	China	120	60	60	20-80	6
Xiao <sup>37</sup>	2018	RCT	China	984	492	492	60-80	3
Lei <sup>38</sup>	2018	RCT	China	142	65	66	≥18	3
Shao <sup>39</sup>	2018	RCT	China	40	20	20	22-60	3
Luo <sup>40</sup>	2018	RCT	China	100	50	50	56-72	6
Bao <sup>41</sup>	2018	RCT	China	78	40	38	31-80	12
Xu <sup>42</sup>	2018	RCT	China	100	50	50	25-62	3
Liu <sup>43</sup>	2018	RCT	China	275	140	135	18-60	6
Li <sup>44</sup>	2019	RCT	China	165	83	82	≥18	12
Li <sup>45</sup>	2019	RCT	China	200	95	94	50-60	3
Xue <sup>46</sup>	2019	RCT	China	120	60	60	30-55	3
Liu <sup>47</sup>	2019	RCT	China	112	56	56	51-70	6
Huang <sup>48</sup>	2019	RCT	China	140	70	70	34-80	6
Gao <sup>49</sup>	2019	RCT	China	100	50	50	37-58	3
Wang <sup>50</sup>	2019	RCT	China	60	30	30	≥65	6
Huang <sup>51</sup>	2019	RCT	China	100	50	50	35-72	6
Jiang <sup>52</sup>	2019	RCT	China	98	48	50	66-79	6
Wei <sup>53</sup>	2019	RCT	China	134	67	67	39-58	6
Ran <sup>54</sup>	2019	RCT	China	90	45	45	30-50	12
Zhang <sup>55</sup>	2019	RCT	China	96	48	48	50-75	12

possible score  $\times 100\%$ ,  $\geq 80\%$  was a high-efficiency level,  $\leq 40\%$  was a low-efficiency level, and the rest was a medium-efficiency level.

The Chinese Normal Audit of Diabetes-Dependent Quality of Life (CN-ADDQOL) measure<sup>16</sup>. The ADDQOL scale had a history of more than 20 years abroad, and the Chinese version was adjusted according to the characteristics of the Chinese population. The

scale included 11 items, divided into five dimensions: leisure activities, emotions, psychological feelings, family life and diet. The score range was (-171)-57 points. The higher the scale score, the better the quality of life of the patient. The Cronbach's  $\alpha$  coefficient of the scale was 0.941, and the relative fitting index of the structural equation model was 0.96%, which had good reliability and validity.



**FIGURE 2** Risk of bias graph (indicators from Cochrane Collaboration risk assessment tool)

## 2.6 | Risk of bias assessment

Quality control was undertaken independently by two authors. Discrepancies were resolved by discussion with a third investigator, or consensus of the whole team if required. RCTs were assessed by Cochrane Collaboration risk assessment tool.<sup>17</sup>

## 2.7 | Statistical analysis

Review Manager for Windows (version 5.3) was used for the meta-analysis. Measures of interest were risk ratio (RR), mean difference (MD) and 95% confidence interval (CI). Fixed-effect model or random-effect model was used according to the absence or presence of significant heterogeneity. Heterogeneity among trials was evaluated by chi-square test ( $P < .10$  means indicate significant heterogeneity) and  $I^2$  test. Publication bias was assessed by funnel plots. We excluded each study one by one so as to evaluate the stability of results. For FPG, 2hPG and HbA1C, favours in forest plot meant better blood sugar control. For self-efficacy score, it meant higher scores and better self-management.

## 3 | RESULTS AND DISCUSSION

### 3.1 | Literature search

A total of 382 records published before 9 March 2020 were identified by search procedure. In addition, no article was obtained from the reference lists. A total of 120 articles remained after the review of titles or abstracts. By the end, 82 articles were excluded after full-text reviews and 38 articles involved 5463 patients were identified.<sup>18-55</sup> The detailed process of literature selection and reasons for exclusion were summarized in Figure 1.

### 3.2 | Study description

A total of 2709 patients received traditional follow-up, and 2709 added WeChat. There were 10 studies<sup>19,20,27,30,39,41,50,52,54,55</sup> with less than 100 patients, 25 studies<sup>18,21-26,28,29,31-33,35,36,38,40,42,44-49,51,53</sup> with 100-200 patients (including 100 and 200), three studies<sup>34,37,43</sup> with more than 200 patients, and the numbers of cases in each

study ranged from 40<sup>39</sup> to 984.<sup>37</sup> All participants were followed-up  $\geq 3$  months, with intervention durations of 3 months in nine studies,<sup>20,42,45,46,49</sup> 6 months in 21 studies<sup>18,19,21,25-30,32,34-36,40,43,47,48,50-53</sup> and 12 months in eight studies.<sup>23,24,31,33,41,44,54,55</sup> All studies reported at least one outcome related to blood glucose, which included FPG, 2hPG and HbA1C. Self-efficacy scale was reported in 11 articles,<sup>7,25,27,33,35,40,46,50</sup> of which were evaluated by SDSCA measure,<sup>3,33,49,53</sup> by SF-36 measure and the rest<sup>38</sup> by DMSES and CN-ADDQOL measure. Characteristics of studies are presented in Table 1.

### 3.3 | Quality assessment

The random sequence generation (selection bias) was considered low-risk in 30 studies, and one study had a low risk based on allocation concealment and blinding of participants and personnel. None of the studies involved selective reporting (reporting bias). All studies had low risks of bias based on other bias. In addition to the high-risk bias of incomplete outcome data of the two studies,<sup>30,33</sup> the remaining studies were low risk. Details of quality assessment are shown in Figures 2 and 3.

### 3.4 | Effects on FPG

Thirty-four studies<sup>18-20,23-33,35,37-55</sup> reported FPG at different follow-up endpoints. It was statistically lower in experimental than control groups (MD: 1.36, 95%CI 1.10-1.62,  $P < .00001$ ; Figure 4). We also observed the same results in subgroups. Significant heterogeneity was found among the studies ( $I^2 = 96\%$ ,  $P < .00001$ ), and random-effect model was used. Sensitivity analysis showed no substantial modification of the estimates after exclusion of individual study one by one. Funnel plot is shown in Figure S1.

### 3.5 | Effects on 2hPG

Compared to control, intervention brought out lower 2hPG after follow-up among 31 studies (MD: 1.91, 95%CI: 1.48-2.35,  $P < .00001$ ; Figure 5),<sup>19,20,23-30,32,33,35,37,38,40-55</sup> so did subgroups. Random-effect model was used because of significant heterogeneity ( $I^2 = 96\%$ ,

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Bao HD 2018	+	?	?	+	?	+
Chen SY 2015	?	?	?	+	?	+
Chen ZX 2017	+	?	?	+	?	+
Dai GQ 2017	+	?	?	+	?	+
Dong CL 2017	+	?	?	+	?	+
Dong YH 2018	+	?	?	+	?	+
Fu Q 2017	?	?	?	+	?	+
Gao CL 2019	+	?	?	+	?	+
Huang P 2019	?	?	?	+	?	+
Huang WE 2018	+	?	?	+	?	+
Huang XH 2017	+	?	?	+	?	+
Huang YJ 2019	+	?	?	+	?	+
Hu YF 2017	?	?	?	+	?	+
Jiang CL 2019	+	?	?	+	?	+
Kang L 2017	+	?	?	+	?	+
Lei C 2018	+	?	?	+	?	+
Liu CJ 2016	?	?	?	+	?	+
Liu JB 2018	+	?	?	+	?	+
Liu S 2019	+	?	?	+	?	+
Li Y 2019	+	?	?	+	?	+
Li YP 2019	+	?	?	+	?	+
Luo J 2016	+	?	?	+	?	+
Luo R 2018	?	?	?	+	?	+
Ran H 2019	+	?	?	+	?	+
Shao Y 2018	+	?	?	+	?	+
Shi XF 2017	+	?	?	+	?	+
Wang LJ 2016	+	?	?	+	?	+
Wang MH 2019	+	?	?	+	?	+
Wei P 2019	+	?	?	+	?	+
Xiao JH 2018	+	?	?	+	?	+
Xue YN 2019	+	+	+	+	?	+
Xu ZY 2018	+	?	?	+	?	+
Yang SH 2015	?	?	?	+	?	+
Ye TF 2018	?	?	?	+	?	+
Yuan DD 2018	+	?	?	+	?	+
Zeng L 2015	+	?	?	+	?	+
Zhang JJ 2019	+	?	?	+	?	+
Zhan YQ 2017	+	?	?	+	?	+

FIGURE 3 Risk of bias summary (indicators from Cochrane Collaboration risk assessment tool)

$P < .00001$ ). The result was reliable by sensitivity analysis after exclusion of individual study one by one. Funnel plot is shown in Figure S2.

### 3.6 | Effects on HbA1C

Significant difference was showed in HbA1C between control and experimental groups<sup>18,19,21,22,24-30,32-39,41-45,47-52,54,55</sup> (MD: 1.07, 95%CI 0.86-1.27,  $P < .00001$ ; Figure 6), and subgroups showed the same result. Significant heterogeneity ( $I^2 = 95%$ ,  $P < .00001$ ) was found, and random-effect model was used. Sensitivity analysis was reliable after exclusion articles one by one. Funnel plot is shown in Figure S3.

### 3.7 | Effects on diet score

Diet score was significantly higher in experimental groups<sup>25,27,33,35,40,50</sup> (MD: -1.31, 95%CI: -1.77--0.86,  $P < .00001$ ; Figure 7). Random-effect model was used due to significant heterogeneity ( $I^2 = 83%$ ,  $P < .0001$ ). Sensitivity analysis showed no substantial modification of the estimates after exclusion of individual study one by one. Funnel plot is shown in Figure S4.

### 3.8 | Effects on exercise score

Exercise scores showed significant differences between two groups among six studies<sup>25,27,33,35,40,50</sup> (MD: -1.92, 95%CI: -2.44--1.40,  $P < .00001$ ; Figure 8). Significant heterogeneity was found among the studies ( $I^2 = 76%$ ,  $P = .0009$ ) and random-effect model was used. The result was reliable by sensitivity analysis after exclusion of individual study one by one. Funnel plot is shown in Figure S5.

### 3.9 | Effects on medication taking score

Compared to control, experimental brought out higher score after follow-up (MD: -1.45, 95%CI: -1.94--0.97,  $P < .00001$ ; Figure 9),<sup>25,27,33,35,40,50</sup> so did subgroups. Significant heterogeneity was found among the studies ( $I^2 = 88%$ ,  $P < .00001$ ) and random-effect model was used. The result was reliable by sensitivity analysis after exclusion of individual study one by one. Funnel plot is shown in Figure S6.

### 3.10 | Effects on monitoring of blood glucose score

Six studies<sup>25,27,33,35,40,50</sup> reported this outcome at follow-up endpoints. It was statistically lower in control groups (MD: -1.17, 95%CI: -1.83--0.51,  $P = .0005$ ; Figure 10). Random-effect model was used and significant heterogeneity was found ( $I^2 = 91%$ ,  $P < .00001$ ).



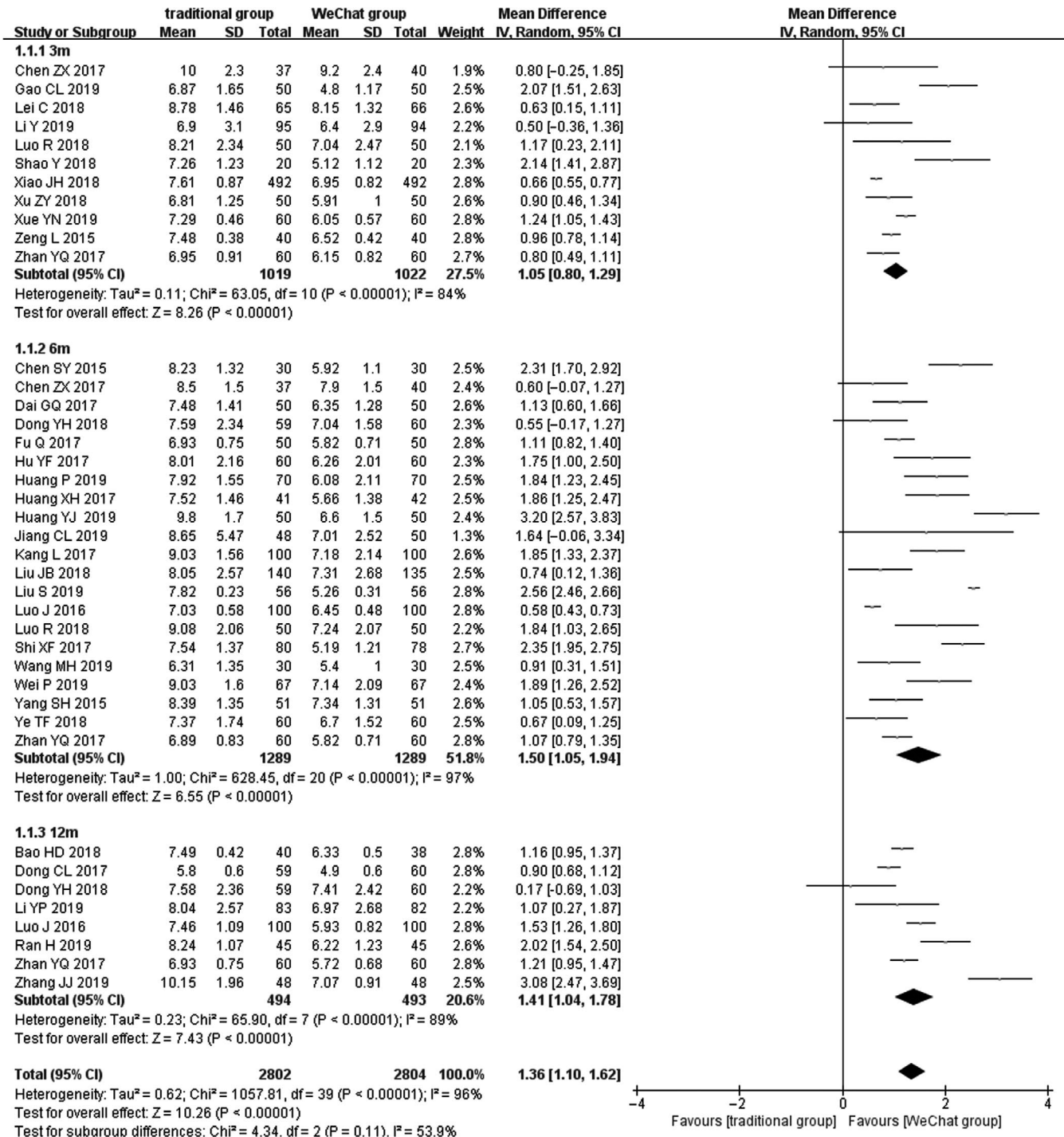


FIGURE 4 Forest plot depicting the mean difference of FPG with traditional group versus WeChat group

Sensitivity analysis was reliable after exclusion articles one by one. Funnel plot is shown in Figure S7.

3.11 | Effects on foot care score

Six studies<sup>25,27,33,35,40,50</sup> reported this outcome, and control groups were statistically lower on this score (MD: -1.71, 95%CI: -2.08- -1.34, P < .00001; Figure 11). Significant heterogeneity was found

(I<sup>2</sup> = 68%, P = .008), and random-effect model was used. Sensitivity analysis was reliable after exclusion articles one by one. Funnel plot is shown in Figure S8.

This was the first meta-analysis based on self-management of type 2 diabetes patients' follow-up using traditional methods or WeChat. Based on FPG, 2hPG, HbA1C and self-efficacy scale, our study evaluated the effectiveness of self-management in patients with type 2 diabetes. The improvement of these indicators would help patients to understand the disease correctly and improve the quality of life.

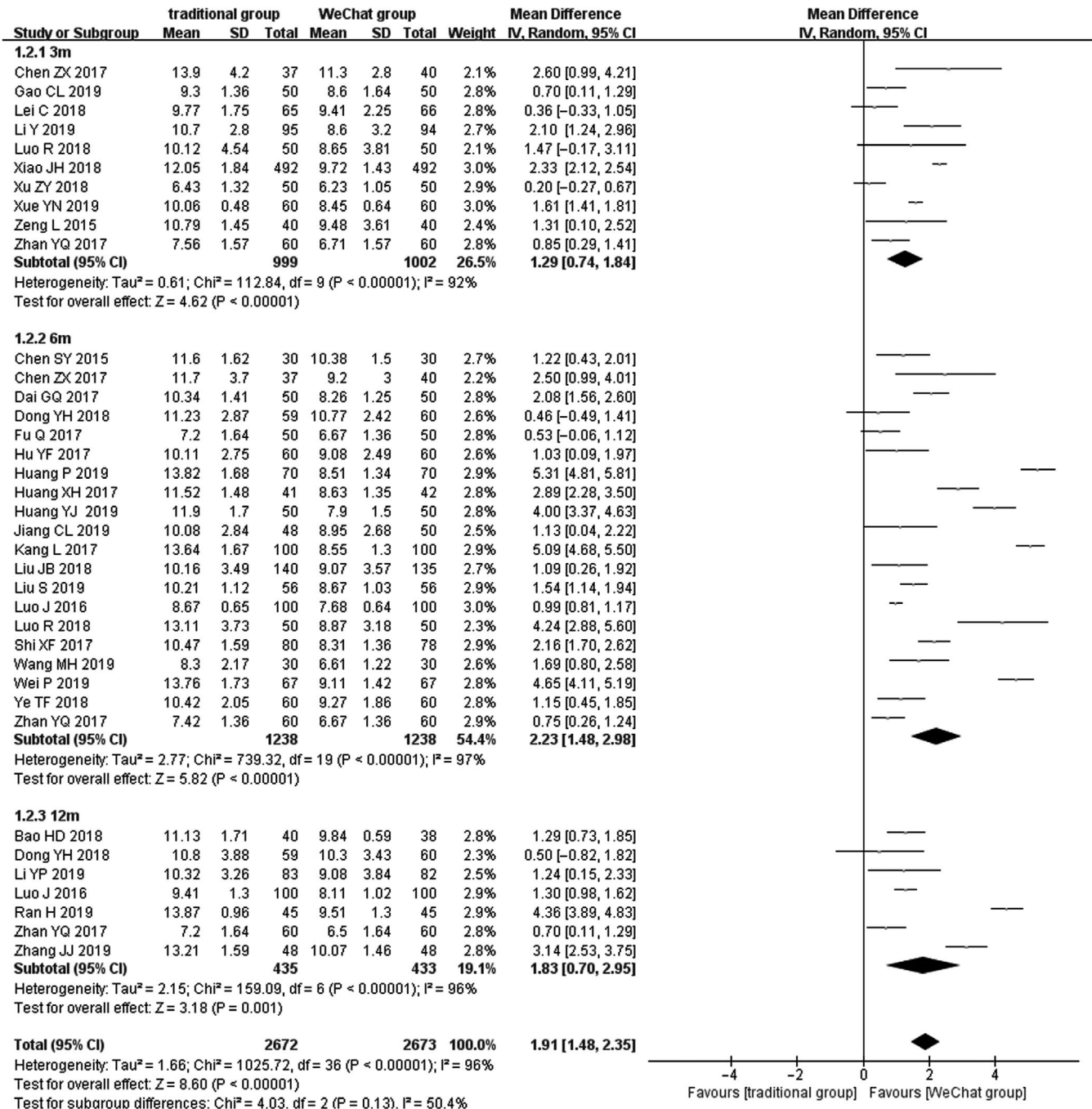


FIGURE 5 Forest plot depicting the mean difference of 2hPG with traditional group versus WeChat group

Significant improvement of blood glucose was an important outcome to evaluate the effectiveness of WeChat follow-up. In our study, FPG, 2hPG and HbA1C were significantly reduced in WeChat group ( $P < .00001$ ). Xu et al<sup>42</sup> and Xue et al<sup>46</sup> reported WeChat follow-up reduced FPG and 2hPG relative to education at discharge or education manual after 3 months, so did HbA1C level. Two articles<sup>19,28</sup> found, compared with telephone, WeChat follow-up could effectively improve the blood glucose related indicators of patients after 6 months. In the same way, WeChat follow-up could reduce blood glucose level more than outpatient follow-up.<sup>30</sup> The reason why WeChat follow-up could significantly improve the blood glucose

level of patients was that it could understand the current situation of patients through a variety of ways (such as texts, pictures, voices and videos).<sup>56</sup> Compared with outpatient follow-up, it was more timely. Meanwhile, it was more comprehensive and intuitive than telephone follow-up. At the same time, the establishment of WeChat group might also realize the 'one to many' follow-up mode<sup>57</sup> (one medical staff corresponds to multiple patients), effectively saving time, and patients could also support each other.

The improvement of self-management ability of diabetic patients after discharge was also one of the advantages of WeChat follow-up. Diet control, exercise therapy, diabetes knowledge education, blood



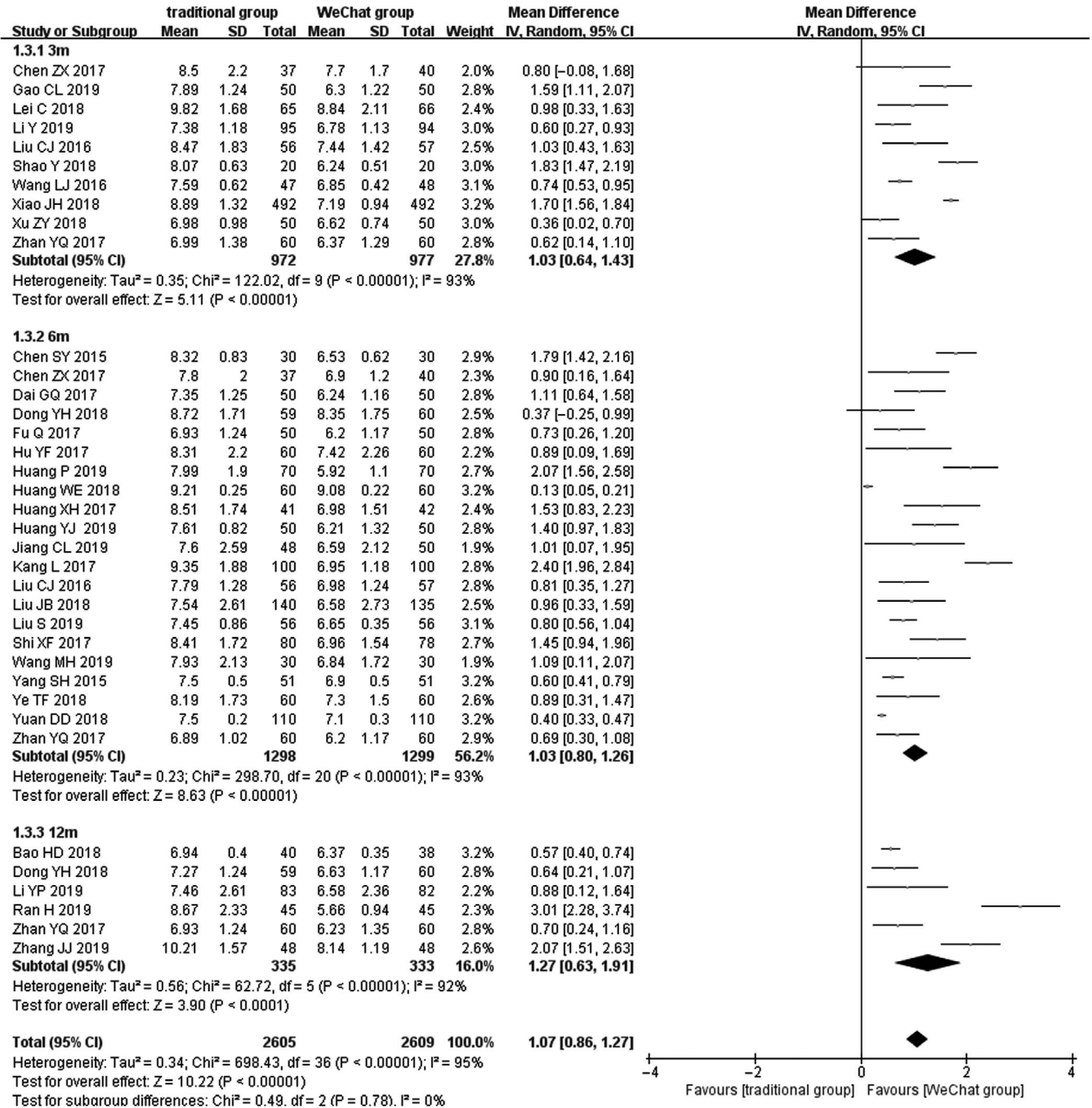


FIGURE 6 Forest plot depicting the mean difference of HbA1C with traditional group versus WeChat group

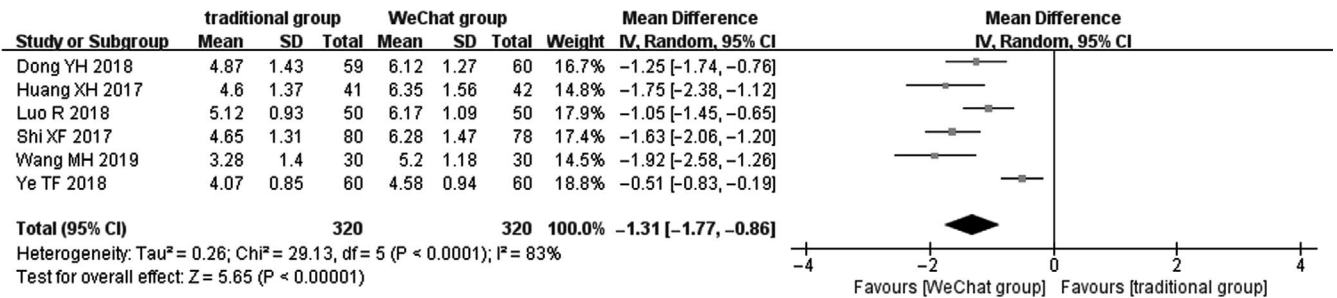


FIGURE 7 Forest plot depicting the mean difference of Diet score with traditional group versus WeChat group

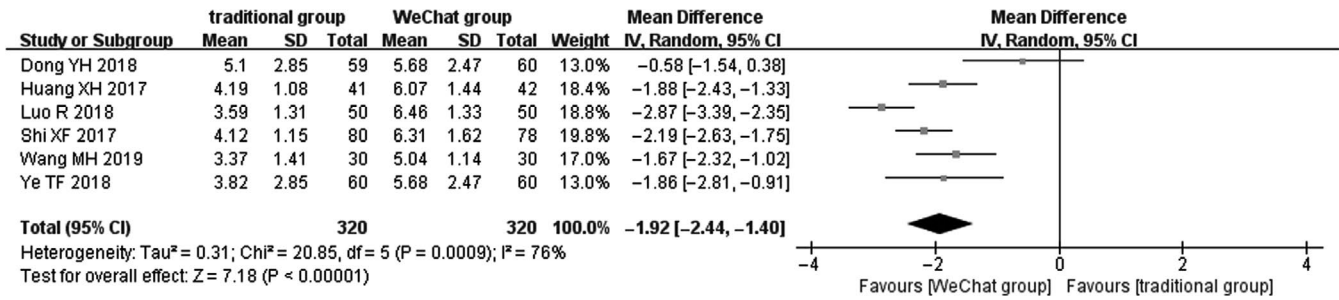


FIGURE 8 Forest plot depicting the mean difference of Exercise score with traditional group versus WeChat group

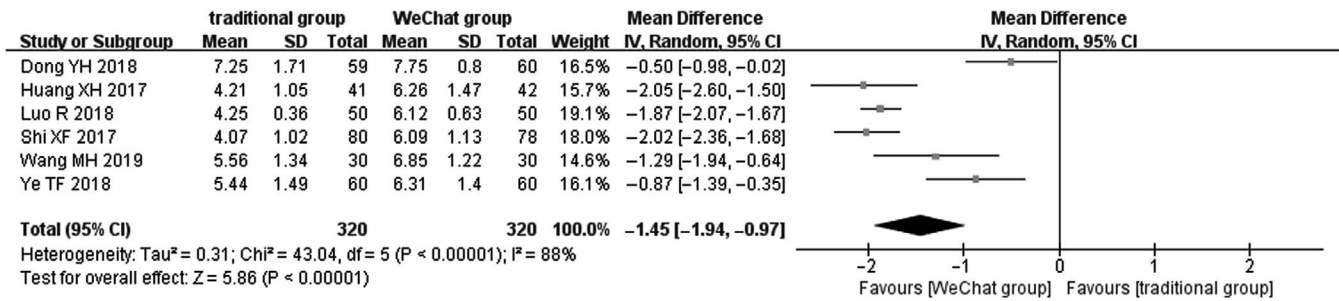


FIGURE 9 Forest plot depicting the mean difference of Medication taking score with traditional group versus WeChat group

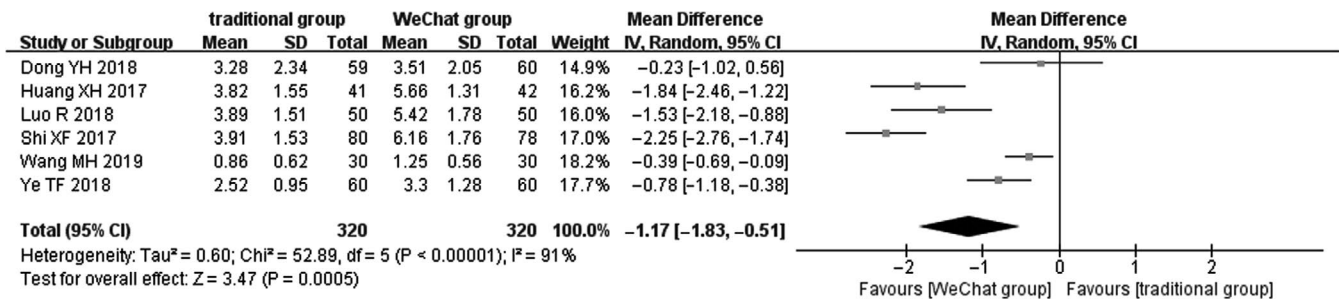


FIGURE 10 Forest plot depicting the mean difference of Monitoring of blood glucose score with traditional group versus WeChat group

glucose monitoring and drug treatment were the five elements of self-management of diabetic patients,<sup>58</sup> and WeChat follow-up could effectively take into account the above aspects. Our results showed that the scores of diet, exercise, medication taking, monitoring of blood glucose and foot care of type 2 diabetes patients after WeChat follow-up were significantly higher than those of traditional follow-up. This was probable because the traditional follow-up model had been unable to meet the needs of patients and their families. WeChat follow-up could update the patient's education content in real time and send it to the patient in time. At the same time, the addition of multimedia forms such as pictures and videos had greatly increased the acceptance of patients. Another advantage of WeChat was it could communicate with patients anytime and anywhere, answer patients' doubts in time, close the relationship between medical personnel and patients, and gain patients' trust. Through timely feedback of patients' problems, patients might develop good self-management habits and improve the quality of life.

Some studies<sup>18,22,28</sup> reported WeChat follow-up could improve patients' satisfaction and laid a good foundation for later treatment.

However, in addition to improving blood glucose level and self-management awareness, the way to improve satisfaction would also be reflected in better understanding of the disease. Many studies<sup>19,32,36,39,43,54</sup> have found after WeChat follow-up, patients had a more comprehensive understanding of the disease. Some of them also believed WeChat follow-up could help patients better use insulin.<sup>47,54</sup> Flexible communication methods and rich communication forms might be the most prominent features of WeChat follow-up. Patients would get information that traditional follow-up model could not get through this method, so as to correctly understand their own diseases and avoid the difficulties caused by cognitive errors.

Hypoglycaemia was the most frequent and dangerous adverse drug reactions (ADR) in diabetic patients.<sup>13</sup> Five studies<sup>24,35,36,44,45</sup> have found WeChat follow-up could reduce the incidence of hypoglycaemia after 6 months. In addition, the incidence of diabetic complications, such as diabetic retinopathy, diabetic neuropathy and diabetic nephropathy, decreased in varying degrees.<sup>35,45</sup> Some serious acute complications such as diabetic ketoacidosis (DKA), diabetic lactate acidosis and hyperosmolar non-ketotic diabetic syndrome

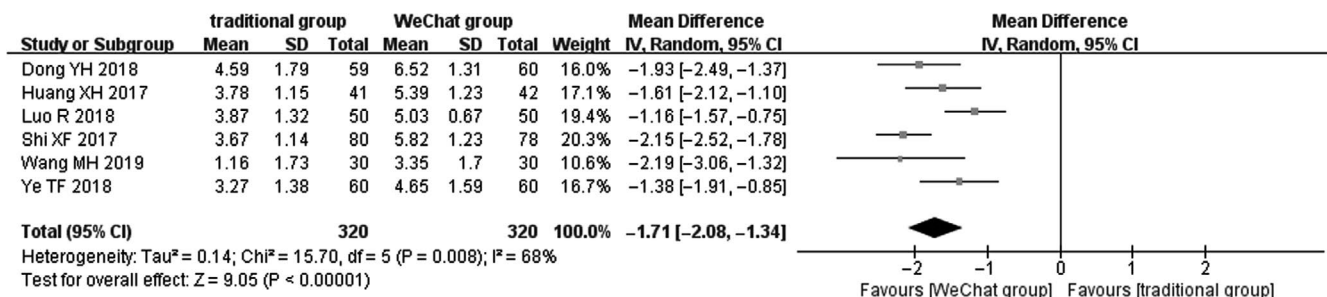


FIGURE 11 Forest plot depicting the mean difference of Foot care score with traditional group versus WeChat group

(HNDS) were also reduced due to WeChat follow-up.<sup>36</sup> It could be seen that WeChat follow-up might effectively reduce the incidence of ADR, at the same time, reduce the hidden dangers caused by serious acute complications and ensure the health of patients.

WeChat was a new social application launched in the past decade, which could realize one-to-one, many to one, one to many or many to many communication mode through texts, pictures, voices and videos. At the same time, the information would be collected and shared to achieve the purpose of anytime, anywhere access and dissemination. Although WeChat itself could not improve blood glucose level and reduce the incidence of ADR and complications, it might help medical staff and patients to establish a good habit of self-management through information dissemination, improving compliance and satisfaction, and bringing significant clinical effect.

Although WeChat follow-up has many advantages, it also has disadvantages. For example, we could not know whether the patient has actually browsed the information, or in the area without network, the information could not be obtained. Therefore, the combination of traditional follow-up forms and WeChat would be more conducive to patient self-management.

This study had several limitations. First of all, the included studies were all Chinese studies, lacking data from Western countries. Secondly, the evaluation of literature quality was not high. Third, the sample size of most studies was small, which might have an impact on the results. Therefore, the results of this meta-analysis needed to be interpreted carefully. In the future, large sample and high-quality studies were needed to confirm the reliability of the results.

#### 4 | WHAT IS NEW AND CONCLUSION

In conclusion, this meta-analysis showed that compared with the traditional follow-up, WeChat follow-up could significantly improve blood glucose and self-management level, reduce the incidence of complications and improve patient satisfaction. However, more high-quality studies with large samples are needed in the future to verify our results.

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#### SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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