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Original Article

Efficacy of blood glucose self-monitoring on glycemic control in patients with non-insulin-treated type 2 diabetes: A meta-analysis

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ABSTRACT

Objective: To evaluate the efficacy of blood glucose self-monitoring on glycemic control in patients with non-insulin-treated type 2 diabetes by performing a meta-analysis.
Methods: Randomized controlled trials (RCTs) of the efficacy of blood glucose self-monitoring were collected from the PubMed, EMBASE, Cochrane Library, CNKI, and VIP databases. Data were analyzed by RevMan 5.1 software.
Results: Seven RCTs were included in this meta-analysis. The results indicated that blood glucose self-monitoring significantly reduced the glycated hemoglobin (HbA1c) level by 0.41%. Subgroup analysis showed that while implementation of a diabetes management regimen based on the blood glucose self-monitoring results effectively reduced the HbA1c level by 0.42%, no significant improvement in HbA1c level control was observed with the implementation of blood glucose self-monitoring alone.
Conclusion: Blood glucose self-monitoring combined with diabetes management effectively improves glycemic control in patients with non-insulin-treated type 2 diabetes.
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1. Introduction

Diabetes has become a public health problem that seriously influences patients' quality of life. Determination of the glycated hemoglobin (HbA1c) level is the gold standard method of evaluating glycemic control in patients with diabetes [1]. Maintaining the HbA1c level at <7% can significantly reduce the risk of diabetes complications [2] and improve the prognosis. However, to achieve such a goal, patients with

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diabetes are required to change their lifestyle based on their blood glucose levels and follow a specific treatment regimen to effectively control their fasting blood glucose and post-prandial glucose levels. Self-monitoring of blood glucose (SMBG) helps patients with insulin-treated diabetes to better understand the role of their blood glucose levels in improving glycemic control [3]. However, randomized controlled trials (RCT) have shown that the efficacy of SMBG on glycemic control in patients with non-insulin-treated type 2 diabetes remains controversial. Poolsup et al. conducted a systematic literature review of RCTs mainly published from 2000 to June 2009 [4]; however, no literature from Chinese databases was included, and some new RCTs have been published since June 2009. Therefore, we performed a meta-analysis of RCTs published since 2000 on the efficacy of SMBG on glycemic control in patients with non-insulin-treated type 2 diabetes.

2. Design and method

2.1. Study selection

RCTs were eligible for inclusion if they (1) compared the efficacy of SMBG and non-SMBG on glycemic control in patients with non-insulin-treated type 2 diabetes and (2) utilized HbA1c (%) as the observation index. Studies that compared the efficacy of SMBG with that of self-monitoring of urine glucose were excluded.

2.2. Search strategies

The following electronic databases were accessed from January 2000 to June 2012: PubMed, EMBASE, the Cochrane Library, CNKI, and VIP. The keywords and strategies used in the literature search were "(blood glucose self-monitoring OR SMBG) AND (type 2 diabetes mellitus OR MODY OR NIDDM)." Using a combination of keywords and free words, we previewed and manually retrieved potentially relevant studies and evaluated the literature references when necessary.

2.3. Data extraction and analysis

Two analysts independently reviewed all studies to ensure that each met the eligibility criteria. The following data were extracted according to the prepared data extraction table: (1) basic information regarding the study, (2) baseline data of the participants, (3) methodological quality, (4) intervention characteristics, and (5) the outcome-measuring index. Controversial outcomes were evaluated by a third party.

2.4. Quality assessment

This study applied the Maastricht–Amsterdam form developed from the Jadad scale and Delphi list to evaluate the methodological quality of each study [5]. The form contains 19 items, 11 of which were used to evaluate the internal validity according to the advice of Welschen et al. [6]: randomization, allocation concealment, baseline comparability, blindness, coordinated intervention comparability, adherence of participants, loss to follow-up, outcome measures, and intention-to-treat analysis. Items with "yes" results were accounted as 1 point, and studies with a score of 6+ were considered "good" while those with a score of 6– were considered "poor."

2.5. Data synthesis and statistical analysis

RevMan 5.1 software supplied by the Cochrane Collaboration was used to conduct this meta-analysis. We used weighted mean differences to count the changes in the HbA1c value. If the value was unavailable, the following formula was used:

$$SD_1(C) = \sqrt{SD_1(B)^2 + SD_1(F)^2 - (2 \times R_1 \times SD_1(B) \times SD_1(F))},$$

where C represents the change in the value, B represents the baseline value, F represents the final value, and R represents the correlation coefficient. Previously reported correlation coefficients range from 0.3 to 0.7 [7–12]; thus, we used a correlation coefficient of 0.5 in the present study. The 95% confidence interval (CI) was used to evaluate the effects. The heterogeneity of the research results was assessed with the chi-square test (Q test). When the results were statistically homogeneous ($P > 0.1$, $I^2 < 50\%$), a fixed-effects model was used; otherwise, a random-effects model was used. The studies were divided into two groups according to whether the health care workers adjusted the diabetes management plan based on the SMBG results: the "adjusted group" and "pure SMBG group." Subgroup analysis was then conducted.

3. Results

3.1. Study selection

The initial search strategy yielded 611 articles. After screening the titles and abstracts, 559 articles were excluded; after reading the full text, a further 27 articles were excluded. The

Table 1 – Characteristics of studies included in the present meta-analysis.

Study	Time	Participants (*n*)		Baseline HbA1c (%, $\bar{x} \pm s$)		Quality score
		Intervention group	Control group	Intervention group	Control group	
Barnett et al. [7] (2008)	27 weeks	311	299	8.12 ± 0.89	8.12 ± 0.84	6
Davidson et al. [8] (2005)	6 months	43	45	8.50 ± 2.20	8.40 ± 2.10	7
Franciosi [9] (2011)	6 months	46	16	7.90 ± 0.60	7.90 ± 0.60	6
Guerci et al. [10] (2003)	6 months	345	344	9.00 ± 1.30	8.90 ± 1.30	6
Kleefstra [11] (2010)	12 months	22	18	7.60 ± 0.50	7.70 ± 0.40	7
O'Kane et al. [13] (2008)	12 months	96	88	8.80 ± 2.10	8.60 ± 2.30	7
Schwedes [12] (2002)	6 months	113	110	8.47 ± 0.86	8.35 ± 0.75	6

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