Systematic review and meta-analysis: Is lifestyle modification effective for glycemic control among adults with type II diabetes in Southeast Asia?

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ABSTRACT
This systematic review with meta-analysis examined whether lifestyle modification (diet and/or exercise) is effective for glycemic control in adults with type 2 diabetes in Southeast Asia. Results showed that lifestyle modification is effective in the short term (3 months), but not over the longer term (6 months) in this population.

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1. Introduction
The worldwide prevalence of diabetes among adults was estimated at 415 million in 2015, and projected to reach 642 million by 2040 [1]. More than 80% of diabetes deaths occur in low- and middle-income countries [2]. From 2000 to 2030, the prevalence of type 2 diabetes mellitus (T2DM) in Southeast Asia is forecast to increase by 161%, compared to a forecasted increase of 72% in the USA and Canada, and 89% in Australia [3].

T2DM prevalence varies by race and ethnicity, and occurs in Asians at lower body mass indexes and younger ages, compared to Caucasians [4,5]. Asians are at higher risk of insulin resistance at a lesser degree of obesity than Caucasians [6]. Many Asian people eat white rice as staple food [7], which has a high glycemic index, and is associated with increased incidence of type 2 diabetes [7,8].

Non-communicable diseases such as T2DM in Southeast Asia likely stem from lifestyles marked by over-consumption, lack of physical activity, excess stress, overweight and obesity [9]. Although intervention studies on lifestyle modification for glycemic control are available, most are in the Western context, and there is a dearth of review evidence for Southeast Asians, who are at a much greater risk.
of T2DM, have unfavorable body composition, and differing lifestyles from Western populations [3,4,6,9]. The objective of this review was to assess whether lifestyle modification (diet and/or exercise) is effective for glycemic control in adults with T2DM in Southeast Asia.

2. Material and methods

2.1. Search strategy

A systematic review and meta-analysis was undertaken on randomized controlled trials (RCT) with interventions that assessed HbA1c or blood glucose effects from lifestyle modification (diet and/or exercise), within Southeast Asian countries. These countries were determined through MeSH (Medical Subject Headings) in PubMed, also conforming to the United Nations definition, and the member states of the Association of Southeast Asian Nations. RCTs were identified using 8 electronic databases. Database searching identified 255 articles (Fig. 1), from which 62 articles were screened for full-text review; from them, 7 articles were included for final quantitative analysis. Detailed inclusion and exclusion criteria are provided in Table 1.

2.2. Quality rating

The risk of bias assessment for the included trials was based on ten criteria adapted from CONSORT for non-pharmacologic treatments [10]. Assessment results are reported in Table 2.

2.3. Statistical analyses

The mean differences (MD) were calculated for post-intervention glycemic outcomes. The $I^2$, Tau$^2$, Chi-squared statistics were computed to assess heterogeneity [11], and random effects models in meta-analysis were used to accommodate heterogeneity [12]. For publication bias assessment, there was no evidence among the included studies of significant asymmetry within funnel plots (data not shown). All meta-analyses were performed by RevMan5 software (version 5.3.0).

Fig. 1 – PRISMA flow diagram.
3. Results

3.1. Search results

Search results are shown in the PRISMA [13] flow diagram (Fig. 1). Selected RCT [7,14–19] characteristics are shown in Table 2.

3.2. Meta-analysis results

Southeast Asian adults with diabetes who received lifestyle modifications for 3 months had statistically significant reductions in HbA1c, compared to the control group. For long term, there were only general lifestyle modification interventions (including diet and exercise self-management and self-care) for 6 months, which showed a non-significant reduction in HbA1c in the intervention group compared to the control group. Detailed results, including sub-group analysis, are provided in Table 3.

4. Discussion

In this review, lifestyle modification interventions (diet, exercise, or general lifestyle interventions) showed a statistically significant reduction in HbA1c, compared to the control groups. The absolute value of HbA1c% reduction (mean difference, MD) was −0.56% (−6.45 mmol/mol), conforming to the reduction range (−0.3% to −0.8%) that previous systematic reviews have found. The US Department of Health and Human Services states that 0.3% decrease in HbA1c is clinically meaningful [20], suggesting that the observed lifestyle interventions resulted in improved health.

4.1. Dietary modification

This review suggests that low glycemic index diets had non-significant improvement on glycemic control, which might be more pronounced if compliance was assured. Compliance with a low glycemic index diet would depend on availability and accessibility of low glycemic index foods within the traditional foods of the population.

4.2. Exercise

Exercise that consisted of 3 months of tai chi qigong, or bicycling had the highest glycemic reduction, and suggests that participants with T2DM tended to comply with exercise programs. Compared to dietary interventions that require diligent compliance over multiple meals per day, exercise required less frequent supervised exercise sessions.

4.3. General lifestyle intervention

The general lifestyle intervention subgroup’s pooled effect size was not statistically significant for either the short term (3 months) or longer term (6 months). Therefore, evidence for such lifestyle interventions is weak. Each lifestyle intervention included elements of diet, exercise, self-management, self-care, and a brief structured education program. Actual intensity and dosage of the intervention components is uncertain.

4.4. Study strengths

The strengths of the present study included focusing on the region with high T2DM disease burden, and greatest increase in prevalence worldwide. The review included all relevant randomized trials from Southeast Asia by extensively searching many electronic databases.

4.5. Limitations

There were few relevant RCTs available that met inclusion criteria. The search was limited to English, and publication in local languages in the electronic databases is rare. Most of the RCTs lacked 6 months or longer intervention periods.

5. Conclusion

Overall, lifestyle modification interventions (diet, exercise, and general lifestyle interventions) are effective for glycemic control among adult T2DM participants in the Southeast Asian context. Glycemic control was improved in the short
## Table 2 – Summary of the randomized trials.

<table>
<thead>
<tr>
<th>Author</th>
<th>Study Country</th>
<th>N</th>
<th>Risk of bias scorea</th>
<th>Mean age (SD)</th>
<th>Sex</th>
<th>Duration of diabetes (SD)</th>
<th>Comorbidity ±</th>
<th>Intervention type</th>
<th>Duration of intervention</th>
<th>Glycemic control measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wattana et al. 2007 [18]</td>
<td>Thailand</td>
<td>147</td>
<td>7</td>
<td>M = 34, F = 112</td>
<td>I = 58.4 (10.05); C = 55.14 (10.22)</td>
<td>I = 5.52 (4.71); C = 5.82 (5.32)</td>
<td>None, H/t, cardiomegaly, cataract, proteinuria, previous stroke</td>
<td>General lifestyle: self-management</td>
<td>6 months</td>
<td>HbA1c</td>
</tr>
<tr>
<td>Keeratiyutawong et al. 2006 [19]</td>
<td>Thailand</td>
<td>81</td>
<td>11</td>
<td>Both sexes; 74% were female</td>
<td>Ranged 27–60</td>
<td>&lt;10 year (inclusion criteria)</td>
<td>Serious illness/C’ were in exclusion criteria</td>
<td>General lifestyle: self-management</td>
<td>6 months (3 months, 6 months assessments)</td>
<td>HbA1c</td>
</tr>
<tr>
<td>Youngwanichsetha et al. 2013 [17]</td>
<td>Thailand</td>
<td>64</td>
<td>6</td>
<td>Exclusively female (post-partum)</td>
<td>I = 35 (5.63); C = 36.16 (4.48)</td>
<td>I = 2.47 (1.24); C = 2.78 (1.18)</td>
<td>18 had C’ (I = 8, C = 10); 46 did not have C’ (I = 24, C = 22)</td>
<td>Exercise: Tai Chi Quigong</td>
<td>12 weeks</td>
<td>HbA1c; FBS</td>
</tr>
<tr>
<td>Yusof et al. 2009 [7]</td>
<td>Malaysia</td>
<td>104</td>
<td>10</td>
<td>Both sexes, breakdown NR</td>
<td>NR</td>
<td>Subjects who had T2DM at least 3 months before the study were selected.</td>
<td>Overweight, high waist circumference, poor glycemic control</td>
<td>Diet: low glycemic index diet</td>
<td>12 weeks</td>
<td>HbA1c; fructosamine; FBS</td>
</tr>
<tr>
<td>Wuttanakorn et al. 2013 [16]</td>
<td>Thailand</td>
<td>76</td>
<td>9</td>
<td>M = 12, F = 64</td>
<td>I = 5.7 (4.9); C = 4.61 (2.88) years</td>
<td>People with obesity, no comorbidity, non-pregnant, (inclusion criteria)</td>
<td>Diet: eating behavior modification program</td>
<td>13 weeks</td>
<td>Blood glucose</td>
<td></td>
</tr>
<tr>
<td>Mitranun et al. 2014 [14]</td>
<td>Thailand</td>
<td>43</td>
<td>9</td>
<td>M = 5+5+5 (C, Contin, Int) = 15; F = 10 + 9 + 9 = 28</td>
<td>I-Contin = 20.5 (1.5); I-Int = 19.5 (1.5); C = 21.1 (2.3) years</td>
<td>No comorbidity, all female were post-menopausal</td>
<td>Exercise: continuous, interval training</td>
<td>12 weeks</td>
<td>HbA1c; FBS</td>
<td></td>
</tr>
</tbody>
</table>

I = intervention, C = control, M = male, F = female, C’ = diabetes complication, Contin = continuous training, Int = interval training, FBS = fasting blood sample.

a Risk of bias score is rated out of 20, larger scores indicate greater risk.
term (3 months) but not over longer term (6 months), conforming to other systematic review findings from Western contexts. From available evidence, exercise interventions have the most significant effect on glycemic control in Southeast Asia. Therefore, lifestyle modification, including exercise, should be an integral part of the therapeutic management of T2DM in Southeast Asia.

Conflicts of interest

Authors have no conflicts of interest that might be interpreted as influencing the research.

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