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Brief report

# Effects of green tea consumption on inflammation, insulin resistance and pulse wave velocity in type 2 diabetes patients

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**Abstract**

In this study, we examined the effects of green tea on inflammation and arterial stiffness in type 2 diabetes patients. As results, inflammatory markers, such as hsCRP and IL-6, were unchanged after green tea consumption, and neither were blood glucose, lipid profiles, insulin resistance, or serum adiponectin levels. Furthermore, tea consumption did not improve baPWV. These results suggest that the above-described mechanisms are unlikely to explain the cardiovascular risk reduction by tea consumption observed in epidemiological studies.


*Keywords:* Tea; Type 2 diabetes; Insulin resistance; Inflammation; Pulse wave velocity

Tea is presently the most widely consumed beverage worldwide [1]. Recent epidemiological studies have strongly suggested an inverse relationship between tea consumption and cardiovascular disease risk [2,3]. Atherosclerosis is generally accepted nowadays as an inflammatory disease, and shares a pathophysiologic mechanism with insulin resistance, primarily due to the actions of two proinflammatory cytokine, TNF-α and IL-6 [4]. Therefore, the mechanism of the beneficial effects of tea in human might be linked to the anti-inflammatory effects of various anti-oxidant polyphenols in tea.

In this study, we explored the effects of green tea on brachial-ankle pulse wave velocity (baPWV), a novel non-invasive means of measuring arterial stiffness, in

*Abbreviations:* hsCRP, high-sensitive C-reactive protein; IL-6, interleukin-6; TNF-α, tumor necrosis factor-α; baPWV, brachial-ankle pulse wave velocity; ABI, ankle-brachial pressure index; NO, nitric oxide; HOMA, homeostasis model assessment

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Table 1
Effect of green tea on cardiovascular risk factors and pulse wave velocity

| | Long-term tea | Long-term water | $p$-Value[b] |
|---|---|---|---|
| Total cholesterol (mmol/l) | 4.6 ± 0.8 | 4.6 ± 0.9 | 0.9122 |
| HDL cholesterol (mmol/l) | 1.1 ± 0.3 | 1.2 ± 0.3 | 0.5620 |
| LDL cholesterol (mmol/l) | 2.7 ± 0.8 | 2.8 ± 0.7 | 0.6529 |
| Triglyceride (mmol/l) | 1.5 ± 0.8 | 1.5 ± 1.0 | 0.7420 |
| Fasting blood glucose (mmol/l) | 6.7 ± 1.3 | 6.9 ± 1.1 | 0.0904 |
| Interleukin-6[a] (pg/ml) | 1.27 ± 1.73 | 1.40 ± 1.94 | 0.5937 |
| hsCRP[a] (ng/ml) | 459.2 ± 3.1 | 432.1 ± 3.1 | 0.4546 |
| Adiponectin (μg/ml) | 6.03 ± 3.71 | 6.01 ± 3.16 | 0.8811 |
| Fasting insulin[a] (μU/ml) | 10.29 ± 1.69 | 10.40 ± 1.47 | 0.7139 |
| HOMA IR[a] | 2.99 ± 1.71 | 3.15 ± 1.51 | 0.4497 |
| Rt. brachial-ankle PWV (cm/s) | 1470 ± 233 | 1481 ± 246 | 0.6998 |
| Lt. brachial-ankle PWV (cm/s) | 1484 ± 252 | 1510 ± 264 | 0.3303 |

[a] Geometric mean ± standard deviation. Logarithmic transformed values are used for testing chronic effect.
[b] $p$-Values are for ANOVA with cross-over experiment.

type 2 diabetes patients. Furthermore, we also examined the effects of green tea on insulin resistance, adiponectin, acute phase reactants (CRP) and on their major cytokine mediator (IL-6).

Fifty-five type 2 diabetes patients (31 men and 24 women) were randomized to either tea-first or water-first group with a cross-over design. The study exclusion criteria contained uncontrolled diabetes, active infection or the intake of drugs known to interfere with vascular function (i.e. lipid-lowering agents, anti-platelet agent, vasodilator, or anti-oxidant vitamin supplements). Subjects who had a habit of regular tea consumption over once a month were also excluded. Informed consent was obtained from all subjects before their participation in the study, which was approved by the ethical committee of our institution. Effects were examined after consuming 900 ml water containing 9 g of green tea daily 4 weeks. Arterial stiffness was assessed at baseline and after each intervention by measuring brachial-ankle pulse wave velocity (ba PWV). Serum adiponectin levels, inflammatory markers were also measured. Insulin resistance (IR) was calculated by homeostasis model assessment (HOMA) [5]. Treatment effects were compared by ANOVA according to its cross-over experiment, respectively.

The age distribution of study subjects was 53.9 ± 7.7 years and their HbA1c was 6.6 ± 0.6. Body mass index (kg/m$^2$) of study subjects was 25.0 ± 2.2 and their HOMA IR was 3.19 ± 1.63. Inflammatory markers, such as hsCRP and IL-6, were unchanged after green tea consumption, and neither were blood glucose, lipid profiles, insulin resistance, or serum adiponectin levels. Furthermore, tea consumption did not improve baPWV (Table 1).

Flavonoids are important group of phenolic compounds in plants. Tea is a rich sources of flavonoids [6]. It is thought that the main cardiovascular effects of flavonoids may come from their anti-oxidant properties. Also, it is known that green tea has an anti-inflammatory effect. In this respect, we hypothesized that the cardiovascular effects of green tea might be linked to the anti-inflammatory effect of green tea. Atherosclerotic changes in the large arteries make an important contribution to the pathogenesis of cardiovascular disease, and increased arterial stiffness is associated with atherosclerosis [7]. However, in the present study, no significant change in CRP, IL-6 levels and baPWV after green tea consumption has been found.

In conclusion, green tea consumption does not influence inflammation, insulin resistance, or adiponectin levels in type 2 diabetes patients. Further, no effect of green tea on arterial stiffness was found. These results suggest that the above-described mechanisms are unlikely to explain the reduction in the risk of cardiovascular events by tea drinking observed in epidemiological studies.

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