



## Good things in life: Can coffee help in diabetes prevention?

Presented at the World Congress on Prevention of Diabetes and Its Complications (WCPD)  
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### Contents

	Page
1 Foreword	3
2 Introduction	3
3 Epidemiological evidence	4
4 Clinical intervention trials	5
5 Clinical parameters	5
6 Underlying mechanisms	6
7 Conclusions	7



## Institute for Scientific Information on Coffee (ISIC)

The Institute for Scientific Information on Coffee (ISIC) is a not-for-profit organization, established in 1990 and devoted to the study and disclosure of science related to “coffee and health.” Since 2003 ISIC has also supported a pan-European education programme, working in partnership with national coffee associations in nine countries to convey current scientific knowledge on “coffee and health” to health care professionals.

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## World Congress of Diabetes Prevention and Its Complications

The World Congress on Prevention of Diabetes and Its Complications is a global forum where experts on diabetes and prevention meet and all participants can enjoy high quality scientific discussions on principles of diabetes prevention and listen to the experiences from diabetes prevention programmes that have been implemented in various countries.

<http://www.wcpd2012.com>

➤ At the 7th World Congress of Diabetes Prevention and Its Complications, ISIC sponsored a session entitled, Good things in life: Can coffee help in diabetes prevention? Speakers at the conference session included:



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**Javeriana University School of Medicine,  
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**Professor Jaakko Tuomilehto**

Professor of Public Health  
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Disclaimer: This report is a summary of the research presented by the above speakers at the 7th World Congress of Diabetes Prevention and Its Complications. It does not necessarily reflect the view of ISIC.



## 1. Foreword

By Dr. Pilar Riobó Serván

“ Coffee consumption has often been linked to poorer health habits, such as smoking and physical inactivity, but, in prospective studies, it has also been associated with a lower risk of developing type 2 diabetes. Despite considerable research, the role of specific dietary and lifestyle factors remains uncertain, although age, obesity and physical inactivity have consistently been reported to raise the risk of diabetes mellitus. The association between coffee consumption and the risk of type 2 diabetes is of considerable relevance because coffee is a widely consumed beverage worldwide and any effect on health that it may cause will have public health consequences. Coffee consumption and the decreased risk of developing type 2 diabetes has been extensively studied in recent years and a growing body of evidence suggests that we may need to change our perception of the health effects of this beverage. ”

## 2. Introduction

Diabetes is one of the world's largest health problems, by 2025 it is estimated that the number of individuals affected by type 2 diabetes will have increased by 65% to an approximate 380 million worldwide<sup>1</sup>. In Europe, it is predicted that one in ten adults aged 20-79 will have developed diabetes by 2030<sup>2</sup>.

Type 2 diabetes is characterised by high blood glucose, together with insulin resistance and relative insulin deficiency. Type 2 diabetes is primarily influenced by lifestyle factors such as diet, physical activity, obesity and age.

Coffee is a widely consumed beverage and research suggests that coffee consumption may help to reduce the risk of developing diabetes.

This report details the key scientific research presented by Dr. Nathan Matusheski , Professor Jaakko Tuomilehto, Dr. Pilar Riobó Serván and Professor Edith Feskens at the World Congress of Diabetes Prevention and Its Complications on 12th November, 2012 during a session entitled: *Good things in life: Can coffee help in diabetes prevention?*



## 3. Epidemiological Evidence

Epidemiological evidence shows that drinking 3 to 4 cups of coffee per day is associated with an approximate 25% lower risk of developing type 2 diabetes, compared to consuming none or less than 2 cups per day<sup>3</sup>.

An early study, published ten years ago<sup>3</sup>, investigated the association between coffee consumption and risk of type 2 diabetes in a cohort of 17,111 adults aged 30-60. Over the follow up period, 360 new cases of type 2 diabetes were identified and after adjusting for potential confounders, individuals who drank at least seven cups of coffee a day were half as likely to develop type 2 diabetes than those who drank two cups or fewer.

### 3.1. Dose response

Research has also suggested a dose response effect of drinking coffee and protection against type 2 diabetes. A systematic review with meta-analysis<sup>1</sup> studied the available prospective epidemiological studies on type 2 diabetes and coffee from 8 different countries. The results showed a statistically significant inverse association between coffee consumption and subsequent risk of type 2 diabetes, with each additional cup of coffee reducing the relative risk by 7-8%.

### 3.2. Coffee and diabetes risk factors

Observational studies have also show that coffee consumption can have an impact on risk factors for type 2 diabetes. For instance, research has found that coffee consumption is associated with lower C-peptide, especially in the overweight or obese<sup>4</sup>, with higher levels of adiponectin<sup>5</sup> and with lower levels of inflammatory markers<sup>5</sup>.

### 3.3. Time of consumption

Research has also suggested that the time of coffee consumption could play a distinct role in glucose metabolism. One prospective cohort study<sup>6</sup> of 69,532 French women examined the long-term effects of coffee on type 2 diabetes and found drinking coffee, especially at lunch time reduced the risk of developing diabetes.

### 3.4. Coffee type

Whilst the majority of research has been conducted on caffeinated filtered coffee, there have also been epidemiological studies that have identified an inverse association between boiled coffee<sup>7</sup> and decaffeinated coffee<sup>1</sup>.



## 4. Clinical Intervention Trials

Whilst studies have clearly illustrated an association between coffee consumption and reduced diabetes risk, a definite causal relationship is yet to be established. Clinical intervention trials are helping to establish this.

### 4.1. Single dose studies

Studies have investigated the effect of a single dose of coffee on glucose metabolism. These have shown no beneficial effects in oral glucose tolerance tests (OGTT), however some studies have shown a modest increase in insulin resistance, attributed to caffeine. One prospective randomized controlled trial<sup>8</sup>, tested glucose and insulin after an oral glucose tolerance test with 12g decaffeinated coffee, 1g chlorogenic acid, 500 mg trigonelline, or placebo. This study demonstrated that chlorogenic acid, and trigonelline reduced early glucose and insulin responses, and contribute to the putative beneficial effect of coffee.

## 5. Clinical Parameters

Drinking coffee is often linked to unhealthier habits, such as smoking and low levels of physical activity, yet counter intuitively; it has also been associated with a reduced risk of type 2 diabetes. So how significant are clinical parameters relating to coffee and type 2 diabetes?

### 5.1. Coffee and hormones

Coffee consumption has been demonstrated to increase levels of the hormone adiponectin, which has been shown to increase insulin sensitivity. This effect has been observed in both diabetic and non diabetic individuals<sup>5</sup>.

### 5.2. Coffee and chronic diseases

In addition to diabetes, research suggests that coffee does not increase the risk of certain chronic diseases. In fact, it is inversely associated some cancers, including bladder, breast, colorectal, liver, pancreas, and prostate cancers. This is important to note, as individuals with diabetes also have an increased risk of developing certain cancers.

### 5.3. Coffee, cholesterol and cardiovascular disease

Some research has shown that unfiltered, but not filtered, coffee increases serum levels of total and LDL cholesterol<sup>9,10</sup>. However, in a small clinical trial, a beneficial effects on HDL cholesterol levels was demonstrated amongst coffee drinkers<sup>11</sup>. Also, despite a high circulating cholesterol being a key risk factor for cardiovascular disease, other studies have illustrated that coffee consumption is not associated with an increased risk of hypertension, stroke or coronary heart disease<sup>12,13,14</sup>. Research in patients with CVD has also shown that moderate coffee consumption is inversely associated with risk of heart failure, with a J-shaped relationship<sup>15</sup>. Additional support for this is provided by a ten year follow up study<sup>16</sup> in which coffee consumption was associated with a lower risk of coronary heart disease mortality. Furthermore, in diabetic patients coffee consumption was not associated with increased risk for CVD or premature mortality among diabetic women<sup>17</sup>.

### 5.4. Coffee and the liver

A healthy liver helps keep blood glucose within the 'normal range' and protects against diabetic complications. Coffee consumption is also associated with higher levels of fetuin-A, a biomarker for inflammation and liver function. It is a glycoprotein secreted by the hepatocytes with effects on insulin signaling via inhibition of the insulin receptor tyrosine kinase in both liver and skeletal tissue<sup>18,19</sup>. Additionally, cross sectional studies have shown coffee consumption to be linked with lower levels of markers of liver damage<sup>20</sup> and a significant reduction in risk of fibrosis among Non Alcoholic Steatohepatitis patients<sup>21</sup>.



## 6. Underlying Mechanisms

### 6.1. The Coffee Conundrum

Coffee consumption has been associated with a decreased risk of developing type 2 diabetes, however a causal relationship has yet to be established. In order to explain this relationship, there are two key questions that need to be answered:

#### ➤ 1. What is the physiology?

There are a number of potential physiological processes that may lead to the reduced risk of diabetes. For example, it could be due to energy metabolism, where by coffee consumption causes an increase in calorie burning, or perhaps coffee affects glucose metabolism causing the body to handle glucose differently. Alternatively coffee could affect insulin sensitivity in the body, as for example, a Singapore Prospective Study found an inverse association between coffee consumption and HOMA-IR, a well recognised marker of insulin resistance. Another possibility is that it could simply be an effect of calorie displacement, where choosing coffee over a sugary drink leads to a reduction in calorie consumption.

#### ➤ 2. What coffee compounds are responsible?

The second challenge is to identify the compounds within coffee which are causing the effect. It could be a known bioactive component in coffee, or even a bioactive substance that has yet to be identified. Alternatively it could be nutrient such as a specific vitamin or mineral. Caffeine has been suggested as the ingredient responsible for the beneficial effects. And again, it is also possible that the effect is the result of the absence of a substance, caused by displacement by drinking coffee in place of other beverages.

Although a consensus has yet to be reached regarding the mechanisms that underlie the association between coffee consumption and type 2 diabetes, a number of plausible theories exist. These include, but are not limited to, the following:

### 6.2. Energy Expenditure Hypothesis

One theory is that caffeine stimulates metabolism and increases energy expenditure. Caffeine acts as an antagonist to adenosine receptors, which play an important role in energy transfer. This effect leads to a build up of cAMP concentration which, in turn, increases the basal metabolic rate – this can lead to a net increase in calories burnt of up to 150 cal/day. However, the limitation of this theory is that experimental data suggests that high levels of caffeine are required, in the region of 600-1200mg/day. This is the equivalent of 6-12 cups of coffee a day.

### 6.3. Carbohydrate Metabolic Hypothesis

Another mechanistic theory has suggested that chlorogenic acid in coffee may play an important role by influencing the glucose balance within the body. This is because chlorogenic acid may inhibit carbohydrate digestion or glucose absorption, which causes glucose concentrations in the liver to decrease. This is thought to modify the responses of certain hormones that cause an increase in the amount of insulin released.



### 6.4. Insulin Sensitivity Hypothesis

There is also a subset of potential mechanisms relating to insulin sensitivity.

#### ➤ 6.4.1. Anti inflammation

Coffee contains components that may modulate inflammatory pathways in the body leading to improved insulin sensitivity. Potential components that have been identified include Caffeic acid phenethyl ester, diterpenes or 3-methyl-1, 2-cyclopentanedione.

#### ➤ 6.4.2. Antioxidants

Coffee contains antioxidants, such as chlorogenic acid and N-methylpyridium these have been shown to mediate the oxidative stress of cells and improve insulin sensitivity.

#### ➤ 6.4.3. Hormonal effects

Some components found in coffee may interact with cortisol metabolism. One in vitro study found that an undetermined bioactive component in coffee caused a decrease in cellular cortisol concentrations, which could improve insulin sensitivity.

#### ➤ 6.4.4. Iron Chelation

Coffee contains phenolics and melanoidins in coffee that may chelate iron. Studies have suggested that a reduction in iron stores may improve insulin sensitivity or cardiovascular health.

## 7. Conclusion

### By Dr. Pilar Riobó Serván

“ The research outlined in this report, suggests that coffee consumption may actually decrease an individual's risk of developing type 2 diabetes. This effect has been linked with higher adiponectin levels, a decrease in inflammatory markers and reduced subclinical inflammation. Furthermore, a dose-dependent, inverse association between both coffee drinking and total mortality has been demonstrated in the general population, as well as among diabetics.

Studies have also found that drinking coffee does not increase cancer risk in diabetic population, nor does it not cause cardiovascular disease, hypertension or stroke. Although more research is needed to make firm conclusions, the findings suggest that coffee can be safely enjoyed by the healthy and as well as by the diabetic population and might even be helpful in diabetes prevention. ”

## Endnotes

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