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Is Curcumin an Antidote for Civilization Diseases? A Literature Review

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ABSTRACT

Introduction and purpose: Curcumin is the main natural lipophilic polyphenol obtained from *Curcuma longa* L. Its anti-inflammatory, anti-cancerous, anti-obesity, antioxidant, and lipid-lowering effects have attracted scientists' attention. Due to its diverse pharmacological properties, curcumin might be a beneficial and promising nutraceutical food dealing with civilization diseases. NCDs (non-communicable diseases) such as obesity, cardiovascular diseases, and diabetes mellitus are significant health issues affecting global society.

Aim of the study: The purpose of this review is to present a thorough analysis of the impact of supplementation curcumin on the prevention, course, and complications of obesity, cardiovascular diseases, and diabetes mellitus.

Material and methods: An analysis of papers available in PubMed and Google Scholar was performed using the following keywords: curcumin, curcumin and Type 2 Diabetes Mellitus, curcumin and chronic diseases, curcumin and obesity, curcumin and Cardiovascular diseases, curcumin and lipid, curcumin and glucose.

Conclusion: As studies have shown, curcumin might be a promising nutraceutical food in treating obesity, cardiovascular diseases, and type 2 diabetes mellitus. Further research should be conducted to assess the impact of curcumin better and to establish the appropriate dose, formulation, and duration of the therapy.

Keywords: Curcumin, Type 2 Diabetes, Cardiovascular Disease, Obesity, Glucose, Lipid

INTRODUCTION

Curcumin is a main natural lipophilic polyphenol obtained from *Curcuma longa* L. (turmeric) [1] rhizome used in Asian medicine and cuisine for centuries, so it has emerged as a candidate to study its natural properties. Numerous studies were conducted to explore its anti-inflammatory, anti-cancerous, anti-obesity, antioxidant, and lipid-lowering effects [2,3]. Due to its diverse pharmacological properties, curcumin might be a beneficial and promising nutraceutical food dealing with civilization diseases. Civilization diseases also known as non-communicable diseases (NCDs) are characterized by slow progression, long duration, and multifactorial etiology. They are the leading cause of death worldwide, with the largest share of cardiovascular diseases, cancers, respiratory diseases, and diabetes [4]. However, the term NCDs covers a range of health problems, in this article, we will focus on providing a thorough analysis of the latest reports on the influence of curcumin on obesity, CVD, and diabetes as those are considered significant health challenges affecting society.

Obesity

Obesity and overweight are major health problems all over the world [5]. According to WHO in 2022 2,5 billion adults were overweight [6]. What is more, it is a known risk factor for developing numerous diseases such as cardiovascular disease [7,8], diabetes [7], cancers [9], as well as it is considered as NCDs itself [4]. Adipose tissue not only stores excessive intake of energy, but it has a role as an endocrine organ while secreting adiponectin and leptin, and proinflammatory cytokines such as NF-kB, tumor necrosis factor (TNFα), interleukin (IL)-6, IL-1β [10] regulate systemic metabolism [11]. Chronic low-grade inflammation might be the link between excessive adipose tissue and previously mentioned diseases [10,12]. While having natural anti-inflammatory properties [3], curcumin became a subject of researchers' interest.

A meta-analysis conducted by Maryam et al assessed the impact of curcumin intake on weight in overweight patients with metabolic syndrome and associated disorders. Significant reduction of BMI, waist circumference, and weight were observed [13]. Additionally, curcumin intake increased adiponectin levels which have anti-inflammatory prosperities by inhibiting NF –kB activation, and decreased leptin levels (pro-inflammatory prosperities) [11,13,]. On the other hand, waist-circumference change was not observed in this and 2 different meta-analyzes [14,15].

A study conducted on 84 overweight and obese patients with NAFLD showed that intake of two 40 mg capsules per day for three months significantly decreased serum inflammatory markers such as hs-CRP, IL-6, and TNF-alpha [16]. Similar conclusions were reached in a

randomized placebo-controlled trial, where 60 overweight and obese adolescent girls were selected. They were administered a slight weight-loss diet and 500 mg/day curcumin intake for 10 weeks. As a result, there was a significant decrease in hs-CRP and IL-6 compared to the placebo group [17].

Cardiovascular diseases (CVDs)

Cardiovascular diseases remain a leading cause of morbidity and mortality worldwide [4], so new therapeutic approaches are needed. Among natural compounds, curcumin has attracted considerable attention due to its potential cardioprotective effects. Key health factors that increase the risk of cardiovascular disease are obesity, smoking, nutrition, physical activity, raised blood pressure, hyperglycemia, and hyperlipidemia [4].

A meta-analysis conducted by Si Qin et al. indicates that curcumin intake significantly reduced serum LDL-C and TG levels compared to the control group. Also, in patients with metabolic syndrome serum total cholesterol level was lower, however, the effect on HDL-C was not favorable. [18].

Campbell et al. investigated whether the enhanced bioavailable curcumin would improve biomarkers related to cardiovascular diseases and arterial function in young, obese men. In a placebo-controlled trial, 22 men took 500mg curcumin formulated with fenugreek fiber daily for 12 weeks. As a result, HDL levels increased, and homocysteine levels decreased. However, this study did not show significant differences in changes in central blood pressure, glucose, insulin, leptin, adiponectin, and endothelial function. [19]. In patients with metabolic syndrome curcumin intake has beneficial effects, significant diastolic blood pressure reduction, decrease in triglycerides levels, and HDL increase were observed [20]. At least 12 weeks of supplementation of curcumin indicated a significant reduction of SBP, but there was no effect on DBP [21].

Curcumin's influence on lipids may be explained by several mechanisms, among others by reducing oxidative stress, increasing expression of LDL-receptor, promoting TG lipolysis, reducing cholesterol absorption, and stimulating fatty acid oxidation. Nonetheless, it remains uncertain which mechanism exerts the greatest impact [20]. Studies show inconclusive and not repeated results on SBP and DBP. Therefore, more trials on hypertensive patients should be conducted [20, 21].

Acute myocardial infarction causes permanent damage to the heart muscle even when treated effectively with thrombolysis, percutaneous coronary intervention (PCI), and coronary artery bypass grafting (CABG). Nevertheless, conducted research suggests that myocardial ischemia/reperfusion (I/R) injury causes unavoidable pathological changes during the

reperfusion process after the revascularization [22]. Furthermore, it leads to myocardial dysfunction, structural impairment, and disturbances in myocardial electrical activity, exacerbating myocardial necrosis and leading to complications like arrhythmia, reduced ventricular function, and death [23]. As it might be connected to inflammation, accumulation of oxygen reactive species, cell apoptosis, and damage to the mitochondrial membrane, curcumin might be a cardioprotective nutraceutical applied in the clinical setting.

A clinical study by Wongcharoen et al. aimed to investigate the effects of curcuminoids on the frequency of acute myocardial infarction after CABG. 121 patients undergoing CABG of whom 61 received 4g curcuminoids per day in addition to standard therapy 3 days before the scheduled surgery until 5 days after surgery. In the group taking curcuminoids, there was a significant decrease in the incidence of in-hospital MI compared to placebo. CRP level, which was measured 3 days after the operation to observe the impact of curcuminoids on oxidative stress and inflammation, was significantly higher in the placebo group. Also, plasma MDA, an oxidative stress marker, was increased after CABG in the placebo group but decreased significantly after CABG in the curcuminoid group. What is more, the average increase in postoperative NT–pro-BNP level compared to preoperative level was greater in the placebo group than in the curcuminoid group [24].

Aslanabadi et al. investigated whether the intake of one dose of 480 mg nano micelle curcumin and standard treatment before PCI have an impact on CK-MB and troponin I. The study did not show any significant changes in tested parameters between groups [25]. Another study, by Prommintikul et al., investigated patients undergoing PCI. Patients in the control group were administered 4g/day at least one day before PCI and 4g 1 day after PCI. There were no changes between the placebo and control group in CRP, troponin T levels, and incidence of PCI-related myocardial injury [26]. Both studies did not show positive effects of short-term curcumin intake before PCI.

DIABETES AND GLUCOSE LEVELS

Type 2 diabetes mellitus is a metabolic and chronic disease growing in the world. Not only good control of diabetes but also prevention and treatment of complications are major public concerns. Researchers are continually seeking novel approaches to manage and potentially minimize its impact. Among natural substances everlastingly studied, curcumin is gaining a growing interest due to its multi-faced biological activity.

A healthy lifestyle understood as a healthy diet, normalized body weight, no tobacco use, and regular physical activity are known as T2DM preventive actions. Curcumin might also be a

prevention agent by affecting glucose parameters, lipids, and body parameters [27]. Chuengsamarn et al. Investigated the efficacy of curcumin in delaying the development of T2DM in the prediabetic population. In the RCT the intervention group was administered 6 capsules, 250mg of curcumin each for 9 months. As a result, 16,4% of patients in the placebo group were diagnosed with T2DM while no one in the intervention group, in which HbA1c, fasting plasma glucose, and OGTT at 2h were significantly lower. Beta-cell function was assessed by HOMA-beta, C-peptide, and proinsulin-insulin ratio, of which HOMA-beta was significantly increased and C-peptide was significantly lower in the curcumin-treated group. Proinsulin-insulin ratio results were not significant. To evaluate insulin resistance HOMA-IR was examined. HOMA-IR level was significantly lower in the intervention group [28].

The subsequent study, conducted by Thota et al., aimed to investigate the effects of curcumin and/or long-chain omega-3 polyunsaturated fatty acids on glycemia and blood lipid levels in patients with elevated risk of diabetes development, impaired fasting glucose, or impaired glucose tolerance. Patients were assigned to 4 groups (placebo, curcumin with placebo, curcumin with fatty acids, fatty acids with placebo), in curcumin groups it was 180mg of curcumin per day. Only in curcumin with the placebo group fasting insulin significantly decreased with no significant changes in fasting glucose, nor HbA1c [29].

When it comes to the complications of diabetes, the most often mentioned are cardiovascular diseases, chronic kidney disease, neuropathy, foot damage, and retinopathy [30]. The effect of Nano-curcumin supplementation on patients with sensorimotor polyneuropathy and T2DM was studied by Asadi et al. Patients in the intervention group received 80mg of nano-curcumin for 8 weeks. The supplementation resulted in a significant decrease in HbA1c and fasting glucose. To measure the neuropathy Toronto clinical neuropathy score (TCNS) was used. TCNS assesses symptoms, sensory (among others temperature), and reflexes. After 8 weeks the test was performed again and there was observed a significant reduction of a total score of neuropathies, total reflex score, and temperature in the intervention group [31].

Adibian et al. Conducted a CRT study to investigate curcumin supplementation's effects on CRP, serum adiponectin, and lipid profile in patients with T2DM. The intervention group received 500mg of curcumin 3 times per day for 10 weeks. At the end of the study, the TG level decreased significantly in the curcumin group compared to the baseline. CRP decreased and adiponectin increased in the curcumin group compared to the placebo group. Both results were significant. These results suggest that patients supplementing curcumin may reduce diabetes complications by reducing TG level and inflammation markers [32].

The disturbance of blood flow and nerve damage hinder wound healing. Mehrdad et al. conducted a CRT study focused on patients with diabetic foot ulcers. Patients who received 80mg of nanocurcumin for 12 weeks had significantly decreased fasting plasma glucose, insulin, - insulin resistance, total- and LDL- cholesterol, and increased insulin sensitivity. Total antioxidant capacity and total glutathione were significantly increased. The researchers did not observe improvement in ulcer dimensions, other lipids levels, hs-CRP, MDA, or HbA1c [33].

CONCLUSION

Curcumin has shown promising potential as a therapeutic agent for NCDs such as obesity, cardiovascular diseases, and diabetes. It has an impact on the reduction of BMI, waist circumference and by increasing adiponectin levels and decreasing leptin levels, reduces low-grade inflammation associated with obesity. Research findings have indicated effects on lipid and oxidative stress regulation. Curcumin has been effective in delaying the onset of type 2 diabetes mellitus and improving glycemic control in diabetic patients. What is more, curcumin has been linked to reduced inflammation and improved antioxidant capacity which can reduce diabetic complications. However, some results are inconclusive. Conflicting study results may be due to differences in formulation, doses, duration of intake, profile of the research group, and external factors. Further research with a bigger sample size, longer duration, and the most bioavailable formula of curcumin should be conducted to establish the impact of this nutraceutical.

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