

“Obesity Leads to Inflammation & Inflammation Is The Mother Of Diseases”

J.C Balachandar^{1*}, M. Jayachandran^{1,2} and Irshad Ahamed³

^{1,2}Dr.Bala's School of Fitness & Preventive Medicine, Faridabad, Delhi-NCR, India

²Department of Physics, Sethu Institute of Technology, Kariyapatti, India

³Consultant Surgeon, Department of General and Minimal Access Surgery, Gunam Superspeciality Hospital, Hosur, Tamil Nadu, 635109

Abstract

Obesity is the accumulation of abnormal or excessive fat which leads to inflammation and disturbs the optimal state of health of an individual. Obesity leads to development of both cardiovascular diseases and non-cardiovascular diseases such as psoriasis, depression, cancer, and renal diseases etc. If level of adiponectin is decreased, a significant predictor of cardiovascular mortality, is associated with impaired fasting glucose, leading to type-2 diabetes development, metabolic abnormalities, coronary artery calcification and stroke, which are all backed by chronic inflammation. Obesity if controlled will help reduce the risks of cardiovascular diseases and other inflammatory metabolic disorders and diseases via inhibiting inflammatory mechanisms. Inflammation created by obesity puts excess load in kidneys leading to severe kidney damage also.

Key words: obesity, inflammation, adiponectin, hypoxia, lifestyle and linking mechanism

Date of Submission: 25-12-2022

Date of Acceptance: 05-01-2023

I. INTRODUCTION

Obesity is associated with a low-grade inflammation of white adipose tissue (WAT) resulting from chronic activation of the innate immune system which can subsequently lead to insulin resistance, impaired glucose tolerance and even diabetes. Recent data indicate that obese WAT is infiltrated by macrophages, which may be a major source of locally-produced pro-inflammatory cytokines. Weight loss is associated with a reduction in the macrophage infiltration of WAT and an improvement of the inflammatory profile of gene expression [1]. To improve digestion, along with promoting the growth of good bacteria in the gut microbiome, this status is conditioned by the innate immune system activation in adipose/fat tissue that promotes an increase in the production and release of pro-inflammatory cytokines that contribute to the triggering of the systemic acute-phase response levels. In recent years, scientists have also found that probiotics can actually help with weight loss through various mechanisms. Probiotics seem like the perfect weight loss companion with anti-inflammatory properties – not only is it good for your gut health, but it is also proven to systematically benefit the immune system, heart, and brain health as well [2]. Fiber is an essential nutrient for a healthy diet and consumption of fibrous diet will reduce inflammation and fat levels. The body does not produce its own fiber and it is unable to digest it either. Instead, fiber is both processed by the good bacteria in your body and is utilized as bulk to stool, which lubricates your colon and pushes it out your body faster. Macrophages are components of adipose tissue and actively participate in its activities. Furthermore, cross-talk between lymphocytes and adipocytes can lead to immune regulation. Adipose tissue produces and releases a variety of pro-inflammatory and anti-inflammatory factors, including the adipokines leptin, adiponectin, and resistin, as well as cytokines and chemokines, such as TNF- α , IL-6, and MCP-1 [3]. With the lack of fiber, our body will not only experience problems with digestion, as it is linked to other conditions and increase in inflammation, such as weight gain, diabetes, strokes, nutritional deficiencies, and cardiovascular problems. By supplementing your body with dietary fibers, your digestive system is sure to be in optimum health by reduction in inflammation. Improving your digestive system will not just lead to bearable bathroom trips – it also positively impacts other areas of our health, such as (i) helps protect against heart disease (ii) helps control blood sugar levels and (iii) helps with weight management & inflammation reduction [4].

Hypoxia is proposed to be an inciting etiology of necrosis and macrophage infiltration into adipose/fat tissue, which leads to overproduction of pro-inflammatory mediators. These results in localized inflammation in adipose tissue that propagates overall systemic inflammation associated with the development of obesity-related comorbidities. In newborn humans, brown adipose/fat tissue helps regulate energy expenditure by thermogenesis mediated by the expression of uncoupling protein-1 (UCP1) [5].

Warnberg et al. [6] designed a study to clarify the association between BMI and low-grade inflammation in Spanish adolescents. Levels of IL-6 showed an elevation with increased BMI in both males and females who were obese, and the same results were achieved for TNF- α for both genders. It has been observed that elevated hs-CRP levels—a classic inflammatory marker is associated with increased risk for incident cardiovascular events among individuals as having the metabolic syndrome.

The metabolite profiles in DME the mechanism of diabetic macular edema (DME) patients differed from those in DM controls. This indicates the following metabolic derangements in DME: (a) a higher amount of oxidized fatty acids but a lower amount of endogenous antioxidants (oxidative stress); (b) higher levels of β -glucose and homocysteine but a lower level of sorbitol (hyperglycemia); (c) a higher amount of prostaglandin metabolites (inflammation); (d) higher amounts of acylcarnitines, odd-numbered fatty acids, and 7,8-diaminononanoate (respiration deterioration); (e) a higher amount of neurotransmitter metabolites and homovanillic acid (neuronal damage); (f) a lower amount of extracellular matrix (ECM) constituents (ECM deterioration); and (g) a higher amount of di-amino peptides (microvascular damage) [7].

II. CASE STUDY

Excess calories or fat in your body is stored as triglycerides within fat tissue or white adipose tissue (WAT). In a person with obesity or excess fat, WAT can become overworked in the body, leading to the death of fat cells and the activation of immune cells, resulting in inflammation. Obesity is the accumulation of abnormal or excessive fat that may interfere with the maintenance of an optimal state of health [8].

The excess of macronutrients or fat in the adipose/fat tissues stimulates them to release “inflammatory mediators” such as “tumor necrosis factor α ” and “interleukin 6”, which leads to reduced production of adiponectin, predisposing to a “pro-inflammatory state” and “oxidative stress” ending up the fatty person with chronic inflammation like what the body goes through during corona. The increased level of interleukin 6 stimulates the liver to synthesize and secrete “C-reactive protein—an inflammatory marker” [9].

2.1 “WHAT IS INFLAMMATION??”

Inflammation is your body’s natural defense system at work. A small amount of inflammation happens when you have an injury or infection. Imagine the swollen area around a sprained ankle or the swelling that occurs in your throat when you have Streptococcal throat infection. It means your body is working to heal itself or fight diseases [10].

2.2 “CAN INFLAMMATION BE BAD FOR MY HEALTH??”

Yes, If you are living with obesity or excess fat, it leads to negative inflammatory response like. A) Overreact to infection or injury, B) Think it needs to act when there is no infection to fight C) Fail to stop the inflammation once your body has recovered from injury or illness, D) The inflammatory state persists leading to chronic diseases [11].

2.3 “CHRONIC DISEASES CAUSED BY INFLAMMATION DUE TO EXCESS FAT OR OBESITY”

- 1.”Diabetes and Insulin Resistance”: Inflammation results from a protein that interferes with insulin action in the liver and fat cells.
- 2.”Heart Disease”: Inflammation forces your heart to work harder which can lead to reduced function.
- 3.”Kidney problems”: Inflammation created by obesity puts excess load in kidneys leading to severe kidney damage.
- 4.”Metabolic Syndrome”: A cluster of conditions which includes high blood pressure, high blood sugar, high cholesterol and excess abdominal body fat caused by inflammation.
- 5.”Psoriasis”: A build-up of surface skin cells that can be painful or itchy caused by inflammation.
- 6.”Cancer”: Long-term inflammation can cause changes and damage to your DNA and lead to cancer.
- 7.”Increased Risk of Infection”: When you have chronic inflammation, your body is less prepared to fight disease.
- 8.”Sleep Apnea”: Can happen when an increased level of protein interferes with fat cells and makes it harder to breathe and process oxygen.
- 9.”Depression”: Obesity based inflammation is often associated with emotional issues, such as sadness, anxiety, and depression.
- 10.”Joint pains”: Obesity based inflammation contributes to soft tissue damage and osteoarthritis.

There is strong evidence for an association between physical inactivity and increased risk for age-related diseases and mortality [12]. The potential of targeting inflammation in specific organs/tissues to treat obesity-linked metabolic disease, the role and mechanism of inflammation will create new opportunities to develop novel therapies for metabolic disease associated with obesity. The origin of inflammation during obesity and the underlying molecular mechanisms that explain its occurrence are not yet fully understood, but pro-inflammatory cytokines play a central role. In obesity, there are higher circulating concentrations of inflammatory cytokines than in lean beings, and it is believed that they play a role in causing insulin resistance [13]. These dietary factors can alter the gut microbiota composition and function and are linked to increased

intestinal permeability and epigenetic changes in the immune system that ultimately cause low-grade endotoxemia and SCI [14]. Our thyroid is going to control a lot of those hormones that affect your metabolism, so any time you have changes in your weight and changes in inflammation, they both alter your hormone fluctuations and the proper balance that all of those are supposed to be in [15].

III. CONCLUSION

Observational studies have shown that a flawless lifestyle backed by regular scientific exercises and dietary patterns similar to the Mediterranean diet, rich in fruit, vegetables, high in monounsaturated fats and fiber, resulted in decreased prevalence of obesity, inflammation and metabolic syndrome. Different mechanisms, including antioxidant, anti-inflammatory, fiber diet, and antiestrogenic processes have been proposed to explain the protective nature of certain dietary components, particularly, components of Mediterranean diet which could be an important therapeutic lifestyle change along with regular scientific exercises to help in avoiding the development of obesity, inflammation and further allows an individual to enjoy a diseases free life at an evidence based level.

REFERENCES

- [1]. Dyck, D.J., Heigenhauser, G.J. and Bruce, C.R., 2006. The role of adipokines as regulators of skeletal muscle fatty acid metabolism and insulin sensitivity. *Acta physiologica*, 186(1), pp.5-16.
- [2]. Aronsson, L., Huang, Y., Parini, P., Korach-André, M., Håkansson, J., Gustafsson, J. Å., Pettersson, S., Arulampalam, V., & Rafter, J. (2010). Decreased fat storage by *Lactobacillus paracasei* is associated with increased levels of angiopoietin-like 4 protein (ANGPTL4). *PloS one*, 5(9), e13087. <https://doi.org/10.1371/journal.pone.0013087>
- [3]. Kurtoglu E, Korkmaz H, Akturk E, Yılmaz M, Altas Y, Uckan A. Association of mitral annulus calcification with high-sensitivity C-reactive protein, which is a marker of inflammation. *Mediators Inflamm* 2012; 2012: 606207.
- [4]. Narayan A, Kulkarni S, Kothari R, Deepak T, Kempegowda P. Association between plasma adiponectin and risk of myocardial infarction in Asian Indian patient with diabetes. *Br J Med Pract* 2014; 7: e729.
- [5]. Hanley AG, Bowden D, Wagenknecht LE, et al. Associations of adiponectin with body fat distribution and insulin sensitivity in nondiabetic Hispanics and African-Americans. *J Clin Endocrinol Metab* 2007; 92: 2665-71
- [6]. Warnberg J, Moreno LA, Mesana MI, Marcos A; The AVENA group. Inflammatory mediators in overweight and obese Spanish adolescents. *The AVENA Study. Int J Obes* 2004; 28: S59-63.
- [7]. Cordain, L., 2012. *AARP The Paleo Answer: 7 Days to Lose Weight, Feel Great, Stay Young*. John Wiley & Sons.
- [8]. Ridker, P.M., Buring, J.E., Cook, N.R. and Rifai, N., 2003. C-reactive protein, the metabolic syndrome, and risk of incident cardiovascular events: an 8-year follow-up of 14 719 initially healthy American women. *Circulation*, 107(3), pp.391-397.
- [9]. Williams, D.E., Prevost, A.T., Whiclow, M.J., Cox, B.D., Day, N.E. and Wareham, N.J., 2000. A cross-sectional study of dietary patterns with glucose intolerance and other features of the metabolic syndrome. *British journal of nutrition*, 83(3), pp.257-266.
- [10]. Panagiotakos, D.B., Pitsavos, C., Chrysohou, C., Skoumas, J., Tousoulis, D., Toutouza, M., Toutouzas, P. and Stefanadis, C., 2004. Impact of lifestyle habits on the prevalence of the metabolic syndrome among Greek adults from the ATTICA study. *American heart journal*, 147(1), pp.106-112.
- [11]. Dijkstra, K.K., Cattaneo, C.M., Weeber, F., Chalabi, M., van de Haar, J., Fanchi, L.F., Slagter, M., van der Velden, D.L., Kaing, S., Kelderman, S. and van Rooij, N., 2018. Generation of tumor-reactive T cells by co-culture of peripheral blood lymphocytes and tumor organoids. *Cell*, 174(6), pp.1586-1598
- [12]. Wadman, M., Couzin-Frankel, J., Kaiser, J. and Maticic, C., 2020. *A rampage through the body*.
- [13]. Christiansen, T., Richelsen, B. and Bruun, J.M., 2005. Monocyte chemoattractant protein-1 is produced in isolated adipocytes, associated with adiposity and reduced after weight loss in morbid obese subjects. *International journal of obesity*, 29(1), pp.146-150
- [14]. Furman, D., Campisi, J., Verdin, E., Carrera-Bastos, P., Targ, S., Franceschi, C., Ferrucci, L., Gilroy, D.W., Fasano, A., Miller, G.W. and Miller, A.H., 2019. Chronic inflammation in the etiology of disease across the life span. *Nature medicine*, 25(12), pp.1822-1832.
- [15]. Bilbo, S.D. and Tsang, V., 2010. Enduring consequences of maternal obesity for brain inflammation and behavior of offspring. *The FASEB Journal*, 24(6), pp.2104-2115.