Developing an Advanced Sciences Module on Inflammation, Obesity and Metabolic Syndrome for the University of Colorado School of Medicine Trek Curriculum

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INTRODUCTION

Obesity and metabolic syndrome, along with the risk factors that contribute to the development of metabolic disease are chief concerns for healthcare providers and public health officials. The incidence of cancer diagnosis, cardiovascular disease, peripheral artery disease, stroke, ischemic heart disease, congestive heart failure, chronic kidney disease, and myriad other disease states are increased in the context of obesity (Fruh, 2016).

According to the CDC the age-adjusted prevalence of obesity, defined by a BMI of >30, among US adults in 2017-2018 was 42.4% (Hales, 2020).

According to the National Health and Nutrition Examination Survey (NHANES) for 1988-2012, the prevalence of metabolic syndrome rose from 25.3% during the 1988-1994 study period to 34.2% in the 2007-2012 study period (Moore, 2017).

Weight stigma has been shown to trigger physiological and behavioral changes linked to poor metabolic health and increased weight gain. In laboratory experiments, when study participants are exposed to weight stigma, their eating increases (Tomiyama, 2018). Furthermore, individuals who report experiencing weight discrimination had a 60% increased risk of death and were 2.5 times more likely to suffer from mood or anxiety disorders (Tomiyama, 2018).

A sample of 2284 physicians showed a severe explicit and implicit anti-fat bias, even among specialists treating obesity-related conditions (Tomiyama, 2018).

METHODS

A literature review was conducted to include high-quality systematic reviews, randomized controlled trials, and case-cohort studies. Searches were conducted through Pubmed with cross reference to primary sources. Controversial or unsettled claims were excluded from the aggregated teaching materials. A pilot of the module was delivered on November 18, 2021 to fourth year medical students. A pre/post survey was administered to participants to assess levels of confidence related to module learning objectives. Each survey question assessed the learner's level of comfort in describing the material learning objectives prior to and immediately after the lecture.

RESULTS

APPROACH
Meeting the learning objectives is achieved through a traditional PowerPoint lecture format. A flipped classroom approach was used to deliver the lecture content. This is accomplished using a fictional case study and discussion/thought questions related to the case. The flipped classroom approach has been described as a key component to efficacious teaching in adult health education (Hew, 2018).

LEARNING OBJECTIVES
- Describe dietary patterns that prime the gut toward a pro-inflammatory state
- Describe the role that NF-kB plays in augmenting the inflammatory signaling and how this cascade influences metabolic syndrome
- Define the role that short-chain fatty acids play in the suppression of inflammation
- Identify the effect of lipopolysaccharides on insulin-sensitive tissues
- Describe the function of the NLRP3 inflammasome
- Define the term "metabolically healthy obesity" and the correlation of this phenotype with the NLRP3 inflammasome
- Identify potential drug targets within inflammatory pathways that show promise in treating/preventing insulin resistance
- Be able to describe the evidence concerning the relationship of inflammation and obesity in clinical practice

RESULTS

THE CASE

A 41-year-old obese male presents to your office to establish a new relationship. He has not seen a doctor in the last ten years. During your interview you discover that he feels well overall with a few "minor" problems. He tells you he has been "peeing a lot more" than he used to. He also indicates he has increased thirst and complains his mouth is dry "all the time". He also indicates that he deals with frequent nausea. His nausea seems to come on shortly after eating and resolves on its own. He indicates occasionally drinking water will improve his nausea. He has no pertinent past medical history. His family history is significant for a mother with diabetes and rheumatoid arthritis and a sister with fatty liver disease. His only medication is occasional bismuth subsalicylate for his nausea. His Temperature today is 37.1 C, Pulse is 92, Blood pressure is 152/96, respiratory rate is 20 and his pulse ox on room air is 93%. His BMI is 43.8.

CASE BASED DISCUSSION/THOUGHT QUESTIONS (examples)
- How would you begin the work-up for this patient?
- What dietary patterns might our patient be accustomed to that would prime his gut microbiome toward an inflammatory state?
- How might increased levels of LPS play a role in the development of insulin resistance in our patient?
- Given what you know about inflammation, what inflammatory lab abnormalities might we uncover in our patient?

LECTURE CONTENT
The content is broken into sections with summary slides at the conclusion of each section highlighting the important learner take-aways. The sections include: *Inflammation Review, Inflammation and the Gut/Short Chain Fatty Acid's, Inflammatory Markers, Inflammation in Insulin Sensitive Tissues, and Pharmacotherapy targets.*

RESULTS PRE/POST SURVEY

QR Code Abbreviated Slides
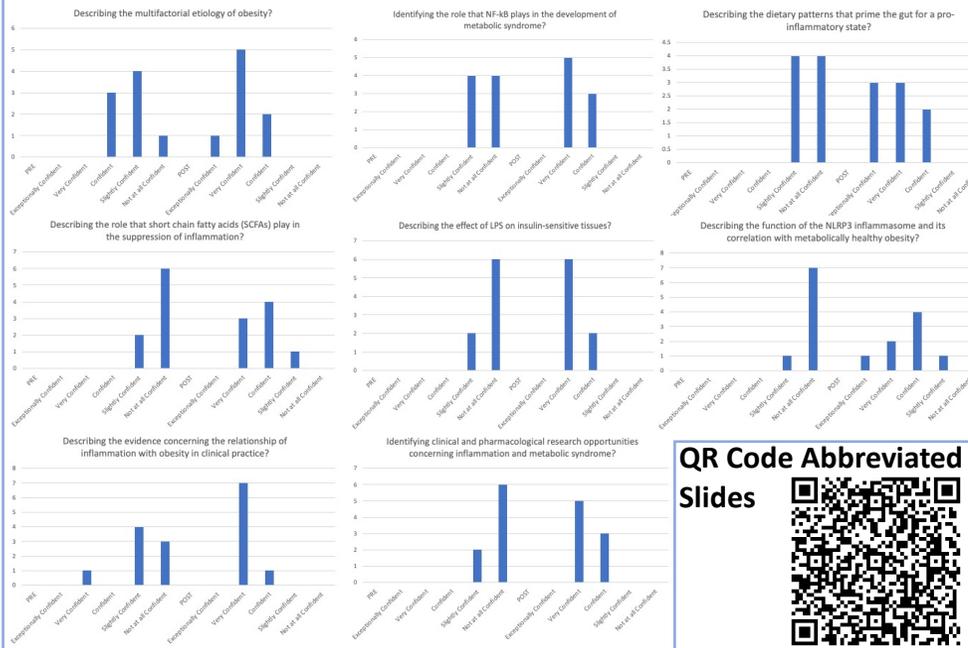
DISCUSSION

LECTURE MATERIAL
This review and resultant educational material aim to clarify our understanding of the etiology of obesity and metabolic syndrome. It also serves to reduce provider bias by addressing the negative stereotype that obesity is a disease of choice and behavior. Importantly, we recognize this material to be an introduction to the non-behavioral drivers of metabolic disease. Other important drivers that require integration into standard medical school curricula include social determinants of obesity and metabolic syndrome, lifestyle changes in the context of the transtheoretical model of change, genetics, the comorbidity of mood and anxiety disorders, and obesity secondary to primary disease pathology. One important limitation to the review and lecture provided here is that the science concerning the gut microbiome and its influence on inflammatory state and obesity is a science still in its infancy. There exists competing evidence as to the degree of change the gut environment undergoes because of nutritional interventions. Also, given the highly complex speciation of bacteria living in the gut, this review uncovered competing claims as to which phyla within the gut play the most prominent roles in the suppression or augmentation of inflammatory signaling. Given the need for future providers to be given an evidence-based education, the decision was made to narrow the focus of the material to exclude unsettled or controversial claims. As stronger evidence becomes available concerning the aforementioned areas the educational material will be updated.

PRE/POST SURVERY
It is clear from the results of the pre-post survey that the approach to teaching the material, including using a case-based discussion model, a reverse classroom approach and providing summary slides to highlight important concepts increased the confidence of learners to describe the inflammatory context of obesity and metabolic syndrome. One important limitation to the pre/post survey results is the number of respondents that participated in both the lecture and survey. Limitations regarding in-person learning at the University of Colorado School of Medicine in the context of the ongoing COVID-19 pandemic hindered a more robust pilot of the lecture. The material will be delivered to larger groups of students as part of the advanced science curriculum for third- and fourth-year medical students. The pre/post survey will continue to be employed for the continued development of the curriculum.

ACKNOWLEDGMENTS/CONFLICTS

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