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Microbiome and Health: Ramifications of Intelligent Deception

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
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Ten thousand years ago, the foundation for agricultural development and animal domestication was laid. Neolithic founder crops were carbohydrate-laden cereal grasses that facilitated transformation of hunter-gather societies into ancient civilizations with realistic capabilities for population expansion. In the last 3–4 decades, however, debilitating medical consequences of a progressively narrowed high caloric diet incorporating processed carbohydrates, animal protein, saturated fat and cholesterol, are translated into a global epidemic of obesity linked to metabolic and endocrine disorders, which, in part, emerged from the enhancement of our longevity. The initiation and progression of pathophysiological processes associated with this restrictive diet may well reside in the gastrointestinal tract. The critical role of human gut microbiome in facilitating normal gut physiology and linkages to other physiological systems points to its significance in comorbid pathologies when its diversity is compromised. Cortical desensitization to the potentially damaging effects of intentionally restricted high carbohydrate diets is progressively enhanced by compromised metabolic activities and widespread pro-inflammatory processes within all organ systems. Our cognitive ability must overcome the desire for comfort foods. The solution is simple: minimize "processed" foods and those of similar commercial origin in our diet, restoring a more diverse gut microbiome. Initially the solution may be costly, however, within the scope of sustained healthy longevity it will "payoff".

MeSH Keywords: **Carbohydrates • Cognition • Diabetes Mellitus, Type 2 • DNA • Genetic Therapy • Hypoglycemic Agents • Microbiota • Mitochondria • Obesity • Symbiosis**

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With the initiation of the Neolithic era 10,000 years ago, favorable environmental conditions within the Fertile Crescent provided the foundation for concerted advances in agricultural development and animal domestication. Accordingly, selective cultivation of Neolithic founder crops that included carbohydrate-laden cereal grasses facilitated transformation of hunter-gather societies into ancient civilizations with realistic capabilities for population expansion. Advances in plant cultivation provided stable, high density, sources of domestic animal feed to effectively expand the human diet to include meat and dairy products with significant fat content. Within the last 3–4 decades, however, debilitating medical consequences of a progressively narrowed high caloric diet incorporating readily available sources of processed carbohydrates, animal protein, saturated fat and cholesterol, are translated into a global epidemic of obesity linked to metabolic and endocrine disorders. Furthermore, exponential development and utilization of genetically modified agricultural sources with exceptionally high yields of carbohydrates appear to be directed towards commercial/financial maximization of human and domestic animal dietary regimens without regard for their significant contributions to comorbid expression of Type II diabetes, cardiovascular/vascular disorders, steatohepatitis, chronic kidney disease, and degenerative CNS disorders, as previously reviewed [1,2].

The elusive search for primary biochemical and/or molecular culprits linking the downward spiral of quality of life, increased morbidity and mortality, to the persistence of unhealthy dietary patterns has been fraught with numerous confounds. For those afflicted with Type II diabetes and obesity-related medical disorders, chronic hyperglycemia is driven by a progressive loss of insulin sensitivity that severely compromises cellular bioenergetics in all peripheral and CNS organ systems. Sorrowfully, cortically-driven neuroendocrine control mechanisms are inadequate in restoring limbic feeding/reward circuits to reestablish healthy dietary patterns in afflicted patients. The dire nature of the decline in dietary health is compounded by the constant barrage of behavioral reinforcement cues evolving from multiple information technology vehicles that are ostensibly designed to robotically target a wide variety of food products solely driven by commercial criteria.

The initiation and progression of pathophysiological processes leading to glucose intolerance, insulin resistance, fulminant obesity, and widespread metabolic disorders may well reside in the gastrointestinal (GI) tract [3–5]. With this in mind, a recent focus of concerted biomedical investigation centers on the critical role of human gut microbiota in facilitating normal gut physiology, maintaining innate immune processes involving intrinsic neurons of the enteric nervous system (ENS) and lymphoid tissues of the GI mucosa [3,6,7], and mediating bidirectional signaling pathways with peripheral organs and the brain [8,9]. Closer examination of functionally interactive enterotypes of gut microflora indicates a higher order organizational complexity devoted to temporally and spatially defined cross-feeding processes designed to maintain the functional integrity of the human microbiome [10–12]. Accordingly, primordial, evolutionarily modified, linkages to past and present dietary patterns reside within diverse, synergistically-linked strains of anaerobic microbiota found in the human gut, and the short term negative effects of carbohydrate-rich diets on altered expression of commensal enterotypes have been documented [10–17]. Notably, a recent study has observed a significant loss of ancestral microbial diversity in human microbiomes relative to those of wild apes [18]. The authors conclude that the comparative depletion of selective phyla, classes, orders, families, genera, and species of human gut microflora, as compared to those of wild primates, reflects a near term evolutionary event driven by a progressive narrowing of human dietary patterns.

In sum, cortical desensitization to the potentially damaging effects of intentionally restricted high carbohydrate diets is progressively enhanced by compromised metabolic activities and widespread pro-inflammatory processes within all organ systems, notably dysbiosis of the human gut microbiome [8,9.19]. We contend that the decrease in bacterial diversity found in humans today may actually stem from the fact that our diet has become increasingly restricted, and based on commercial criteria. As we enhance our food supply with largely the same compounds – namely, carbohydrates with high glycemic index – we limit our ability to meet molecular threats, such as external and internal immune challenges. In essence, our selectively driven unhealthy choices of processed foods severely limit the genetic diversity of essential strains of gut micro biota, which was apparently present in ancestral progenitors approximately 10,000 years ago. Thus, our cognitive ability must over come the desire for comfort foods not give into it, realizing that the immediate benefit does not hide the potentially harmful outcome. The solution is simple: minimize “processed” foods and those of similar commercial origin in our diet, and recognize that what we may be creating via technology may also be detrimental to our health. Initially the solution may be costly, however, within the scope of sustained healthy longevity it will “payoff”.

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Ms Rachel Fine is a senior and an Honors Student at St Anthony’s High School and has been part of numerous high profile science activities.

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