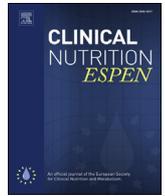




Contents lists available at ScienceDirect

Clinical Nutrition ESPEN

journal homepage: <http://www.clinicalnutritionespen.com>

Original article

Diagnosing clinical malnutrition: Perspectives from the past and implications for the future

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ARTICLE INFO

Article history:

Received 7 February 2018

Accepted 14 May 2018

Keywords:

Malnutrition

Marasmus

Undernutrition

Malnutrition diagnosis

History

SUMMARY

This review, intended for both researchers and clinicians, provides a history of the definition of clinical malnutrition. Despite global efforts, we remain without one clear, objective, internationally accepted definition; clarity in this regard will ultimately improve our evaluation and monitoring of nutritional status to achieve optimal patient outcomes. In this review we explore the development of the term malnutrition and its diagnosis and application in the setting of acute and chronic disease. We begin in the second century A.D. with the work of the Greek physician Galen who is credited as the first to apply the term marasmus to characterize three categories of malnutrition, which are surprisingly similar to components of current international definitions. We then highlight significant developments over the next 2000 years culminating in our current application of the clinical diagnosis of malnutrition. A perspective on historical practices may inform current efforts toward a global definition and diagnosis of malnutrition.

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Introduction

Within the clinical realm few would contest the central role of malnutrition in adverse clinical outcomes. The variable terminology and criteria used to define malnutrition, however, create challenges in interpreting and comparing study results. Despite global efforts to define malnutrition, including consensus statements by the E.S.P.E.N [1], and the Academy/A.S.P.E.N., [2], we remain without one clear, objective, internationally accepted consensus definition. This has led to the pursuit of various proposed markers of nutritional status that may or may not be linked to improved clinical outcomes. A perspective on historical practices may facilitate refinements in the definition and diagnosis of malnutrition, which could ultimately improve our evaluation and monitoring of nutritional status to achieve optimal patient outcomes.

The history of the clinical diagnosis of malnutrition is extensive. The 1974 paper by Dr. Butterworth entitled “The Skeleton in the Hospital Closet” is often viewed as one of the first papers to identify and address the widespread problem of clinical malnutrition [3]. Although considered a seminal paper in the context of our current healthcare system, the overall concept of disease-related malnutrition dates back to ancient Greece [4,5].

History of malnutrition I: before the 15th century

Documentation of an observed relationship between food and functional status, in the form of manual labor, dates back to 2000 B.C [6]. Despite evidence of this earlier observation, Greek physicians, whose work would not be performed until many years later, are often credited with characterizing the relationship between nutrition and health [7]. Their writings established an understanding of the role of nutrition in health and disease nearly 2500 years ago, which remained relatively unchanged for the next two millennia.

Early civilizations viewed food consumption as the provision of a single nutrient, which may have impaired recognition of

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<https://doi.org/10.1016/j.clnesp.2018.05.006>

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nutrition's larger role in health and disease. In general, it appears that this relationship was not re-examined until the advent of chemistry (allowing for the identification of specific nutrients) [7]. Therefore, the following section will attempt to sketch a timeline delineating the understanding of malnutrition prior to the 19th century. During this time, two seminal works were completed on the topic of malnutrition. The first was completed by Galen around 176 A.D., and the second was completed by Bernard of Gordon in the early 1300s [4,5].

Galen

The relationship between nutritional status and health was documented at length by Greek physicians in the centuries around 200 B.C. Hippocrates is well known for his belief that “medicine had its origin in nutritive disturbances” [7]. With regard to nutrition and disease, Hippocrates noted that “the same diet does not suit men in sickness as in health” [7]. Aristotle appreciated that food is “what animals are constituted of” and advanced the theory of “innate body heat” that would serve as the premise within which nutrition and health would be viewed for the next 2000 years [7,8].

The first seminal work that we identified specific to the subject of malnutrition was completed by Galen, a notable Greek physician in the post-Hippocrates era [5]. Galen appears to have been the first to use the term “marasmus” in his book, *De marasmo* around 176 A.D. The term, in the context employed by Galen, meant to wither, dry up, waste, or decay. He provided the following explanation, “... marasmus can be thought of as being either the state of having faded away, or otherwise as the process of fading ...” [5]. Of significance was Galen's use of the term “marasmus”, as it reflects how the term “malnutrition” is being employed clinically today (i.e. an ambiguous term that generally reflects undernutrition at a macronutrient level) [2]. In *De marasmo*, Galen identified three types of marasmus. The first was marasmus due to starvation and was “considered as being simple.” The two complicated types of marasmus were a type associated with cold specific to aging and a type associated with heat specific to fevers. In his book, Galen clarified that what was previously being referred to as “aging resulting from sickness” was actually more accurately “marasmus that comes from sickness” [5]. Thus, Galen appears to be the first author to have made an attempt at describing what we would now consider different forms of malnutrition [2].

Galen discussed a number of physical signs used to identify malnutrition that are still utilized in clinical practice today. Although both anthropometric measures and a clearly defined nutrition-focused physical exam were non-existent, the physical “withering” that Galen discussed is still an important component of the current criteria to diagnose malnutrition [2]. Galen alluded to the observed outward physical characteristics associated with disease-related malnutrition when he stated, “when the body becomes thin after it has been sick for a long time ...” and in chapter II of *De marasmo* Galen noted the following: “... he was so shriveled and dried out, that he, himself, presented the features of impending death, as described by Hippocrates in his ‘Book of Prognostics’: a sharp nose, hollow eyes, collapsed temples ...” [5]. These characteristics are certainly recognized by today's clinicians conducting the nutrition-focused physical exam to identify muscle and adipose loss [9].

Regarding the treatment of malnutrition, Galen wrote, “At present it suffices to say this: solid bodies that have dried out need food.” [5]. He also made the astute observation, although only with regard to marasmus of old age, that when physicians diagnosed and attempted to treat this type of marasmus they were able to “cure” thinness but not wasting [5]. Although he was unaware of the physiology surrounding this phenomenon, it seems he had a rudimentary understanding that body fatness is not completely

reflective of nutrition status—something that clinicians continue to struggle with to this day.

The importance of nutrition in health and disease was acknowledged in the writings of Greek physicians, as evidenced by Galen's work. However, they lacked an understanding of the physiological importance of nutrients and believed that food was simply nourishment or fuel for the innate heat within each person. Interestingly, this belief in innate heat allowed physicians to develop an elementary appreciation of metabolism and changes associated with growth and age long before metabolic rate was able to be measured [5,7,10]. Although nutrition played a prominent role in the ancient understanding of health and disease, another comprehensive work dedicated solely to the topic of malnutrition would not be completed until Bernard of Gordon addressed the topic more than a millennium after Galen [4].

Bernard of Gordon

Bernard of Gordon, a prominent French physician in the Middle Ages, completed *De marasmode secundum sententiam Galieni* in the early 1300s [4]. Although his work was heavily steeped in Galenic tradition [7], Bernard of Gordon relied on translations of Galen's original work, which introduced various interpretations of the term “marasmus” [4]. Because of this, Bernard spent the first chapter of his work *De marasmode* conducting an exegesis of the word “marasmus”, which gravitated toward an interpretation focused on the concept of “drying out”. For example, the historian Demaitre noted that the following metaphor played an important role in both Galen and Bernard of Gordon's understanding of marasmus associated with fevers: “The oil lamp, on the other hand, became the universal image of life, with incineration of the substance of a wick as the standard analog for marasmus ...” [4].

Demaitre details the extensive confusion surrounding various words related to marasmus and its definition at the time of Bernard of Gordon's work on the topic [4]. As previously mentioned, ambiguity surrounding the definition of malnutrition and malnutrition-related terms (e.g. sarcopenia, frailty, and cachexia) is an ongoing problem that continues to this day [11–16]. In a general sense, the understanding of malnutrition (termed marasmus) during the period in which Bernard of Gordon wrote *De marasmode secundum sententiam Galieni* was similar to our current understanding of the disease – where the incineration of the substance of a wick reflects what we would now consider wasting and loss of body cell mass. Demaitre argues that a heavy reliance on analogies limited the scientific progress during this time period, but it is worth noting that the analogies themselves were quite perceptive.

History of malnutrition II: 1400s-1970

Beginning in the 15th century, an important transition in science and medicine began to take place as the reliance on rote learning of classical medicine began to shift to one of observation and experimentation. Paracelsus (1493–1547), an iconoclastic and controversial physician, rejected Galen's classical approach to nutrition and was one of the first to attempt to interpret nutrition utilizing chemistry [7]. It would not be until the mid-1800s, however, that investigators would be able to demonstrate the conversion of chemical energy to heat and mechanical work [7]. It was during this time period that V. Regnault (1810–1878) would demonstrate that metabolism (viewed from the standpoint of energy) varied by age, gender, and size [7]. Further, although the concept of a “metabolic pool” was present at this time, it would not be until the early to mid-1900s that Schoenheimer, utilizing a stable isotope of nitrogen, would detail what we now know as the “metabolic pool” [7].

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