

# Has the Time Come to Start a Dialogue About the Role of Nutrition and Our Inner Microbiomes In Education? Teacher and Faculty Perspectives

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## Abstract

The purpose of this study is to determine if educational professionals at the high school and college levels believe that their students should be required to complete a Health and Nutrition and/or a Microbiology course for graduation. The study used both a descriptive survey and a questionnaire as data collection instruments. The study population was comprised of **655** teachers and instructors from high schools, colleges and universities across the U.S.A. Quantitative analysis was conducted using descriptive statistics. Qualitative analysis of open ended responses was organized into multiple themes. While all the participants strongly agreed that our nation (U.S.A.) is facing critical challenges in overcoming the new trends in obesity, diabetes, infectious diseases and other related epidemics, as well as on the role of education in solving the matters, they differ on what to do and how to prepare the current and future generations. At the college level, while over half of all the participants (61.22%) preferred to see Microbiology as a part of the graduation requirement from college, only 41.22% of the same participants felt comfortable in making Nutrition a part of the graduation requirement. At the high school level, while 42.59% of all the participants saw no problem in including Nutrition as a part of the graduation requirement from high school, only 10.53% of the same participants felt comfortable including Microbiology as a graduation requirement from high school. *More detailed outcomes are presented in this paper.* However, more participating college instructors compared to high school teachers did not think either of the topics should be mandated for graduation from high school or college; the only exception would be if these two fields of study

were part of their selected academic program. Instead, this group of participants suggested making changes to existing course design and content (such as the required “health” or Biology classes), which would offer valuable additions to the existing curriculum and prepare students in health and nutrition. Finally, almost all of the participants provided various reasons and justifications for their perspectives on the matter. The study also shows a significant role for administrators and academic leaders in this requirement process (decision making process for the curricula). Recommendations based on the findings are provided and discussed below.

**Keywords:** General education, Nutrition, Microbiology, Human Microbiomes, Obesity, Diabetes, Illness prevention, Infectious diseases, Education, burden of disease, educational reform.

## 1. Background and Rationale

### 1.1. Introduction

The overall world population is expected to reach over 10 billion by the year 2050. While India (projected population of 1.62 billion) and China (projected population of 1.28 billion) are contributing the most to this rapid increase in population, the U.S.A. population alone is expected to increase to 438 million by the year 2050, with a sizable growth of 48% between 2005-2050 (e.g., Kochhar, 2014; Stepler, 2016). The U.S. is currently in the midst of a health epidemic that is driven in part by often preventable lifestyle choices such as poor diet and lack of exercise. There is a rapid increase in the rate of obesity and diabetes among the world population, with serious consequences to human health and wellbeing. For example, about one in three children are overweight or obese currently. Studies show that children who are overweight are more likely to develop adverse health problems such as diabetes, depression, asthma, and heart failure in adulthood (e.g., Lohrmann, Jayawardene, and Gillio, 2016; Alliance for a Healthier Generation, 2016, 1&2). Today, around 79-80 million people in the U.S. are estimated to have prediabetes; a condition where the blood sugar (glucose) level of a given person is higher than it should be, but not in the diabetes range. This person is on the path to become diabetic, but it is not too late for him/her to turn things around and avoid becoming a diabetic (e.g., Perlmutter & Loberg, 2015). Failure to do so among the prediabetic individuals may lead to increasing their risk of a heart attack or stroke by 50%. Yet, the estimated number of people who know they are prediabetic is only about 7%. Without proper knowledge and training on how to identify that they are at risk, these individuals will not have the opportunity to mitigate the damage already done, or to prevent further negative health consequences later in life. Since eating food is a necessary component of our lives, it is important for us to know what we are putting into our bodies and how it will likely affect our well-being (e.g., Ioannidis, 2018; Berkoff and Schwarcz, 2018; Denton, Lawson, and Armstrong, 2016; Pollan, 2008; Taubes, 2007; Chadwick, 2004). One example of how a required course in nutrition could be helpful is to stop the propagation of false notions such as ‘healthy obesity’ or ‘fat but fit’. There are studies that have shown that overweight individuals have a higher risk of stroke or heart attack, even if they have normal blood pressure, cholesterol, and are not diabetic (e.g., Mundasad, 2017; Therrien, 2018).

Loberg, 2015; Berkoff and Schwarcz, 2018; Ioannidis, 2018). What we eat not only has a major impact on us, but also on all the microorganisms that inhabit our body as their natural biomes (our normal flora) (e.g., Perlmutter and Loberg, 2015). Scientists have estimated that human cells make up only 43% of the human body’s total living cell count. Most of the remaining (57%) are really microscopic colonists (bacteria, fungi, and archaea) (e.g., Wenner, 2007; Gallagher, 2018; Humphrey, 2018). Their presence is essential to human health, survival and well-being. In fact, there is a clear indication that neither human nor any other life form on the planet can live and survive without these microbes. The microbiome can affect many aspects of human life including biological, psychological and emotional states. (Kim, Namhee, et. al, 2018). Thus, our understanding of the interplay between health, nutrition and microbiology should be considered an important life skill, much like reading, writing, and communication. As Professor Rob Knight from the University of California San Diego recently stated, “we are more microbe than we are human.” Similarly, as Professor Sarki Mazmanian, explained, “The combination of our DNA, plus the DNA of our gut microbes, is what makes us human” (Gallagher, 2018, ¶. 7 & 14).

As reported in a recent report about the Chemistry of Microbiomes by the National Academies of Sciences, Engineering, and Medicine (2017):

*The 21st century has witnessed a complete revolution in the understanding and description of bacteria in ecosystems and microbial assemblages, and how they are regulated by complex interactions among microbes, hosts, and environments. The human organism is no longer considered a monolithic assembly of tissues, but is instead a true ecosystem composed of human cells, bacteria, fungi, algae, and viruses. As such, humans are not unlike other complex ecosystems containing microbial assemblages observed in the marine and earth environments. They all share a basic functional principle: Chemical communication is the universal language that allows such groups to properly function together. These*

*chemical networks regulate interactions like metabolic exchange, antibiosis and symbiosis (i.e., antagonistic versus advantageous associations), and communication. (p. 1)*

Considering the critical role that a healthy lifestyle, eating habits, and the status of our own body's microbiomes play in healthy human development, the question becomes: Isn't it time that all students (at some point in their education) be taught about the role of proper nutrition and about the microbiome that inhabits the body and without which we cannot survive? Isn't it time for making a Nutrition and/or a Microbiology course/s required for graduation from high school and/or college? Without knowledge of good nutrition and microbiology, how, for example, can humans protect themselves and their families and friends against the menaces of pandemics, the reality of antibiotic resistance, the reemergence of diseases previously wiped out? How can people prevent obesity from early ages, and in turn prevent early diabetes in young men and women, especially when there are no obvious symptoms seen in someone with prediabetes? Without this knowledge, how can the nation develop and implement a societal mission whereby all individuals could lead long healthy lives free of preventable disease, disability, injury, and premature death? (Koh and Parekh, 2018). Should the U.S.A. common core educational standards recommend that all states include current content in the already required Health Classes or a new standalone class covering the foundations of Nutritional Science and human microbial biology?

In this study, a number of high school teachers and college instructors in the U.S were asked to share their perspectives on whether or not mandatory topics dedicated to health and nutrition and/or microbiology should be added to the curriculum and the reasons behind their beliefs and perspectives. Can the knowledge and information of health and nutrition and microbiology help students from early ages to become nutritionally and epidemiologically aware young citizens? Could they then know how to use this information to plan and evaluate strategies to prevent the potential for obesity, infectious diseases, and other illnesses, before they occur and/or how to manage when/if these matters have already developed? After all, learning is influenced by the state of one's mind, and the state of mind is influenced by the gut microbes, which thereby are influenced largely by the food eaten. In other words, can the understanding of the interactions of the food eaten and the microbiomes of our inner ecology, help humans protect themselves, their community, the nation, and the world? It is not a surprise that many scientists have come to the realization that:

*It would be naive to think we carry around so much microbial material without it interacting or having any effect on our bodies at all. Especially since science is rapidly uncovering the role the microbiome plays in digestion, regulating the immune system, protecting against disease and manufacturing vital vitamins to name a few.*

(Gallagher, 2018, ¶. 15-16)

David Pulmetter (2015), 3 years prior to Gallagher, already had noted the need for a paradigm shift in the thinking of microbes. He in turn harkened back to the words of the renowned geneticist, J. B. S. Haldane some one hundred years back. Haldane warned people from focusing on pathogenic germs instead of understanding the whole human system and its physiology; he noted that this mode of thinking would be crippling to the full understanding of the microbiome, and its place in humankind.

*The system – the human body – is no doubt largely dominated by, controlled by, defined by, comprised of, and orchestrated by the gut's microbial residents. ... If we hope to make headway in improving our health, we can no longer rely on thinking that what ails us can be blamed squarely on a single germ or even a single genetic mutation. The chronic conditions of today, especially those that end up crippling or disabling the neurological system and brain, are diseases of the body's entire system. And that system, to be sure, include the microbiome. (Perlmutter and Loberg, 2015, p.266)*

Today, scientists recognize the profound impact that microbes have on every aspect of human life and the world in which we live (e.g., Perlmutter and Loberg, 2015). Adding to that is the fact that the "global trend towards industrialization and urbanization has led to ever more people living and working indoors [in] Human-made built environments" (Kelley and Gilbert, 2013). This type of human-made environment also contributes to the creation of our modern germ-free life which some scientists have speculated might be the cause of the most common type of cancer in children (Gallagher, 2018b, ¶. 1). Indeed, the majority of people in the developed world spend more than 90% of their time indoors, which makes it even more urgent for humans to learn and understand how our natural microbiome changes in response to these unnatural environments, and what the 'downstream effects' on public health will be. After all, as Kelley and Gilbert (2013) stated, "today, in the developed world, people are born in hospitals, raised in homes or apartments, work in office buildings or factories and move to nursing homes in their old age" (ibid, ¶. 1).

## 2. The Study

A total of **1200** surveys were distributed through the Internet during the years of 2014-2017 to high school teachers and college instructors. The survey was sent to teachers and faculty, among those who have already published papers and research studies in the *American Biology Teacher* journal, as well as the journals *Science Teacher*, *College Science Teaching*, *ACUBE*, and *Science Education and Civic Engagement*. The rationale for this targeted population in the study is that first, it is our belief that we have a better chance with those who conducted and published research to answer our survey because they value endeavors such as this. Second, because of their research experience they might be more interested to participate than those who might not have experiences such as this. Third, the need to communicate with targeted participants was easily available due to their published work and thus, we could follow up with them if needed for additional clarification. Each of the targeted participants teach at least one life science, biology, or biology related subject in his/her academic field or discipline.

At the end, a total of **655 (or 54.5%)** high school teachers and college instructors completed the survey and participated in this study. As Table 1 shows, of those **655** participants, **280 (42.74%)** of them teach at the high school level and **375 (57.25%)** of them teach at the college level.

Table 1  
 Breakdown of Respondents' Institutional Academic Level

Respondents' Institution's Academic Level (n=655)		Total	
		No.	Percentage
1	College and Universities Faculty and Instructors	<b>375</b>	<b>57.25 %</b>
2	High School Teachers	<b>280</b>	<b>42.74%</b>
Total		<b>655</b>	<b>100.00%</b>

The data collection instrument for the study used a descriptive survey, as well as a questionnaire (with specific, pointed questions), and was distributed through the Internet. Interviews via the phone, and follow-up communication through e-mails with selected participants took place to clarify points, explanations, etc. While the data generated from open-ended questions is not easy to compile and quantify, this format is often the best way to determine respondents' complete knowledge, feelings and understanding of an issue (e.g., Anderson, 2010; PSU, 2006). Table 2 shows the questions asked in the survey.

Table 2: The Survey's Format and Main Questions

Survey Questions	
Given the current rate in the world's increase in human population, the spread of infectious diseases and other related epidemics, the ineffectiveness of antibiotics, the obesity among both young children and adults, and the rise in prediabetes and diabetes and their consequences among the human population, do you agree or disagree and why with:	
	<i>Is there an urgent need to leverage formal education to tackle these matters?</i>
	<i>Is it time to make a nutrition field and/or a microbiology field as part of general education requirement for graduation from high school and/or college?</i>

## 3. Results

### 3.1. Overall Total Responses For Inclusion or Lack of Inclusion of Subjects Under Investigation

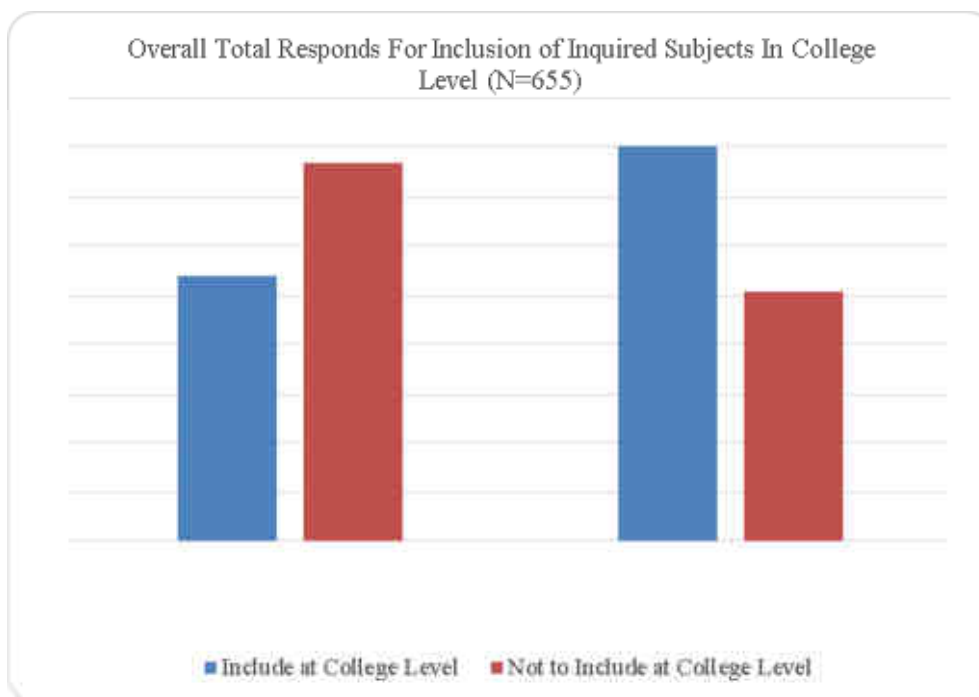
#### 3.1.1: Overall Total Responses for Inclusion of Inquired Subjects at the College Level (N=655):

Table 3 below shows the overall total responds of all the **655** participants in this study in relation to the inclusion of the inquired subjects at the college level. In looking at the overall total responds, while **41.22 %** of all the participants indicated that they feel comfortable making Nutrition as a part of general education requirement for graduation from college level, **58.6%** of all the participants didn't prefer to do so.

Table 3  
 All Participants Overall Total Responses at the College Level (N=655)

Overall Total Responses for Inclusion of Inquired Subjects at the College Level (N=655)					
Inquired Subject	Prefer to Include at College level		Prefer not to Include at College level		Total
	#	%	#	%	
Nutrition	270	41.22%	384	58.62%	655
Microbiology	401	61.22%	254	38.77%	655

Chart 1



On the other hands, while **61.22%** of all the participants felt comfortable making Microbiology a part of a general education requirement for graduation from college, **38.77%** of the same participants didn't prefer to do so. In short, as seen in Table 3 and Chart 1, more participants have no problem of including microbiology (**61.22%**) than including nutrition (**41.22%**) as part of the graduation requirement from college level. By the same talking, more participants didn't prefer to include nutrition (**58.62%**) than microbiology (**38.77%**) as part of the graduation requirement from college level.

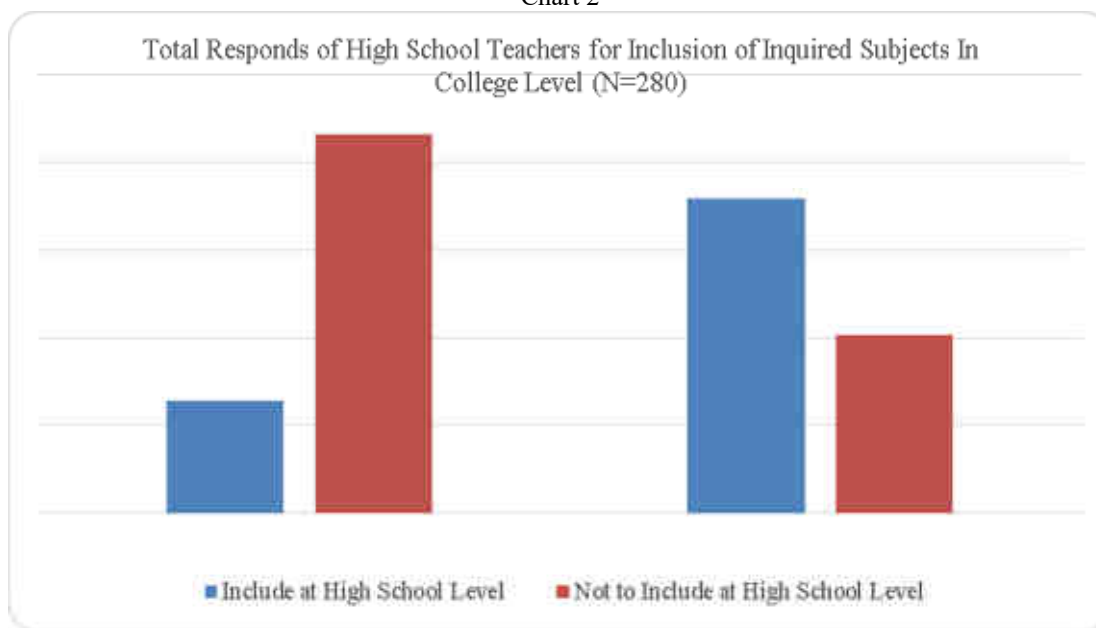
3.1.2: Overall Total Responses for Inclusion of Inquired Subjects at the High School Level (N=655):

Table 4 below shows the overall total number of responses of all **655** participants in this study in relation of inclusion of the inquired subjects at the high school level. In looking at the overall total number of responses, while **42.59 %** of all the participants indicated that they feel comfortable making Nutrition as a part of a general education requirement for graduation from high school level, **54.35%** of all the participants didn't prefer to do so. On the other hands, while **only 10.53%** of all the participants indicated that they feel comfortable making Microbiology a part of the general education requirement for graduation from high school level, the majority of the participants (**89.46%**) didn't feel comfortable making Microbiology a part of the graduation requirement for high school. In short, as seen in Chart 2, more of the participants see *no need for including* than the need *for including* both subjects (Nutrition and Microbiology) as a part of the graduation requirement for from high school.

Table 4  
 All Participants Overall Total at the High School Level (N=655)

Overall Total Responses for Inclusion of Inquired Subjects in High School (N=655)					
Inquired Subject	Prefer to Include at High School Level		Prefer not to Include at High School Level		Total
	#	%	#	%	
Nutrition	279	42.59%	356	54.35%	655
Microbiology	69	10.53%	586	89.46%	655

Chart 2



Noting Table #4, respondents at the college level, over half of all the participants (**61.22%**) preferred to see Microbiology as part of the graduation requirement from college. Also, over half of all the participants (**58.62%**) preferred not to see Nutrition as part of the graduation requirement from college. At the high school level, as seen in Chart 2, the majority of all the participants (**89.46%**) didn't feel comfortable seeing Microbiology as part of the graduation requirement from high school. Furthermore, over half of all the participants preferred not to see Nutrition as part of the graduation requirement from high school level either.

Finally, **16% (105)** of all the participants saw no need for including either subject as a part of the graduation requirement from either high school or college; as well, none (**0%**) of the participants felt comfortable including both subjects together as a part of the graduation requirement for high school or college (Table 9).

### 3.2. Total Responses of High School Teacher Participants

#### 3.2.1. Total Responses of High School Teacher Participants for Inclusion of Inquired Subjects at the College Level (N=280)

Table 5 below shows the overall total responses of all **280** high school teacher participants in this study in regards to the inclusion of the inquired subjects at the college level. In looking at the overall total responses, while **22.85%** of all the participants indicated that they feel comfortable making Nutrition a part of the general education requirement for graduation from college, **77.14%** of all the participants preferred not to see

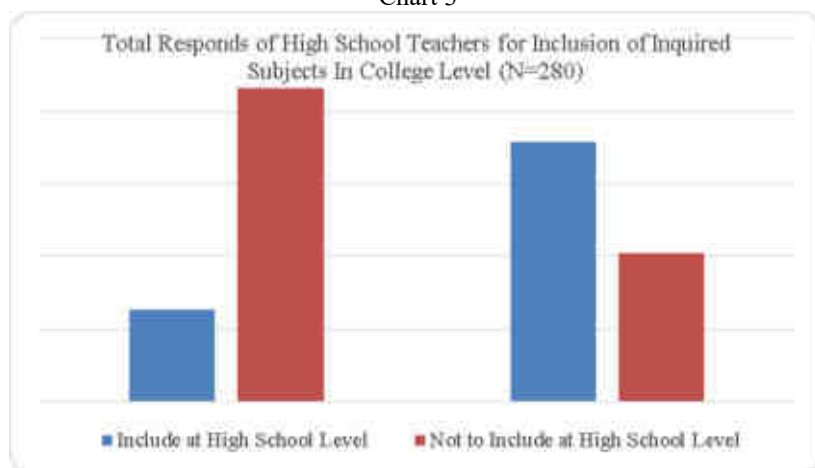
Nutrition as a part of the graduation requirement from college. On the other hands, **63.92%** of all the participants indicated that they felt comfortable making Microbiology a part of the general education requirement for graduation from college. However, about **36.42%** of all the participants that are high school teachers didn't feel the same about the inclusion of Microbiology. In short, as seen in Chart 3, while the majority of all the high school teacher participants did not feel comfortable including Nutrition (**77.1%**) as a part of the graduation requirement from college, the majority of them had no problem including Microbiology (**63.92%**) as a part of the graduation requirement for college.

Table 5

Total Responses of High School Teachers Participants for College Level Inclusion (N=280)

Total Responses of High School Participants for Inclusion of Inquired Subjects at the College Level					
Inquired Subject	Prefer to Include at College level		Prefer not to Include at College level		Total
	#	%	#	%	
Nutrition	64	22.85%	216	77.14%	280
Microbiology	179	63.92%	102	36.42%	280

Chart 3



3.2.2. Total Responses of High School Teacher Participants for Inclusion of Inquired Subjects at the High School Level (N=280)

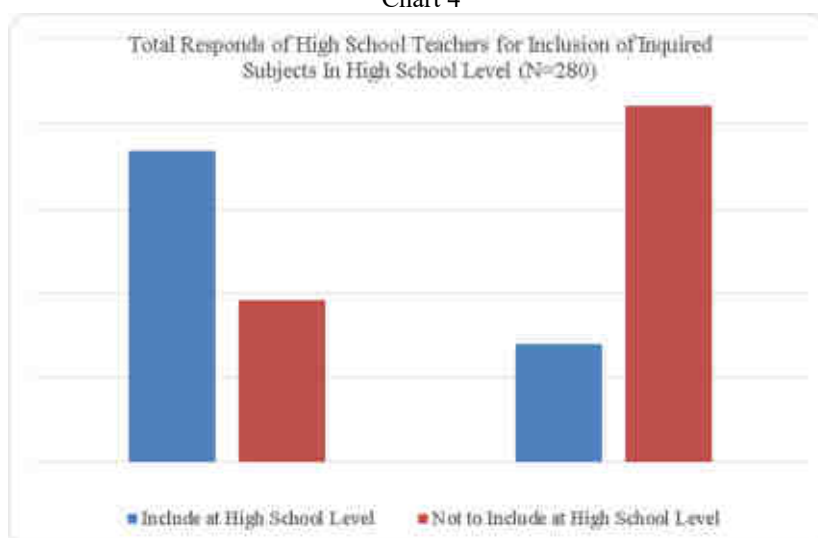
Table 6 below shows the overall total responses of all the **280** participants in this study in regards to the inclusion of the inquired subjects at the high school level. In looking at the overall total responses, while **65.71 %** of all the participants indicated that they feel comfortable making Nutrition a part of the general education requirement for graduation from high school, **34.28%** of all the participants did *not* prefer to see Nutrition as a part of the graduation requirement from high school. On the other hands, while **24.64%** of all the participants indicated that they felt comfortable making Microbiology a part of the general education requirement for graduation from high school, the majority of the participants (**75.35%**) did not feel comfortable making Microbiology a part of the graduation requirement from high school. In short, as seen in Chart 4, the majority of all the high school Teachers Participants feel comfortable including Nutrition (65.71%), but didn't feel comfortable including Microbiology (75.35%) as a part of general education requirement for graduation from high school level.

Table 6

Total Responses of High School Teachers Participants for High School Level Inclusion (N=280)

Total Responses of High School Participants for Inclusion of Inquired Subjects at the High School Level (N=280)					
Inquired Subject	Prefer to Include at High School level		Prefer not to Include at High School level		Total
	#	%	#	%	
Nutrition	184	65.71%	96	34.28%	280
Microbiology	69	24.64%	211	75.35%	280

Chart 4



In summary, as seen in Chart 3 and Chart 4, at the college level, more than half of all participants that are high school teachers (**63.92%**) preferred to see Microbiology as part of the graduation requirement from college. Also, the majority of these participants (**77.14%**) preferred to not see Nutrition as part of a graduation requirement from college. At the high school level, over half of all high school teachers participants (**65.71%**) felt comfortable to see Nutrition as part of the graduation requirement for high school. Furthermore, about 2/3 of all high school teacher participants (**75.35%**) preferred to not see Microbiology as part of the graduation requirement from high school.

Finally, it is important to mention that a total of **57.48% (or 376)** of all the participants (**655**) see no need for including both subjects together as a part of the graduation requirement from high school. On the other hands, only **16.03% (105)** of all the participants (**655**) see no need for including both subjects together as a part of the graduation requirement for college. (Table 9)

### 3.3. Total Responses of College Faculty Participants

#### 3.3.1. Total College Faculty Responses for Inclusion of Inquired Subjects at the College Level (N=375)

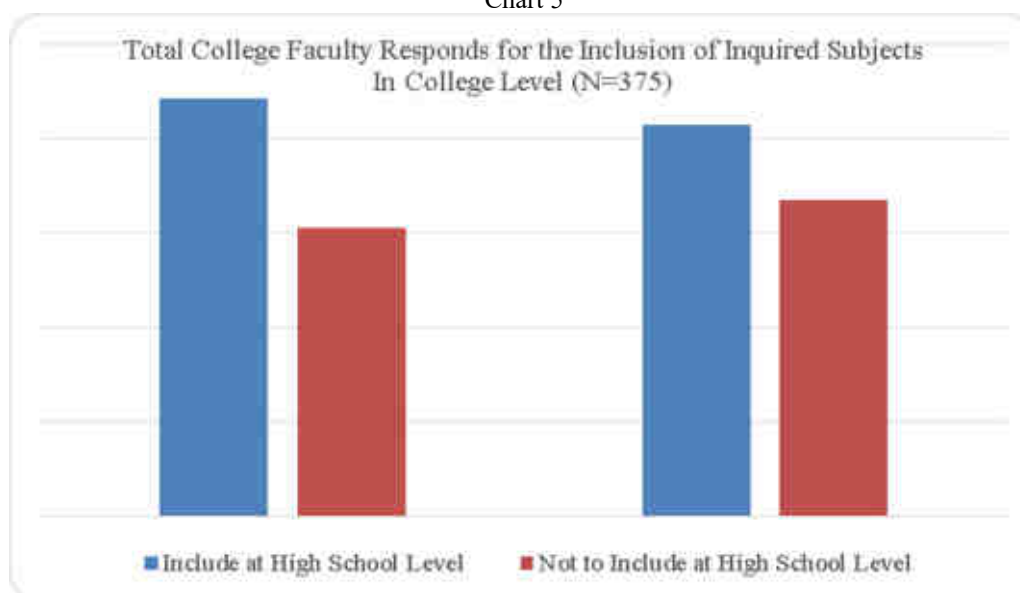
Table 7 below shows the overall total responses of all the **375** college faculty participants in this study in relation of inclusion of the inquired subjects at the college level. In looking at the overall total responds, about **55.2%** of all the participants indicated that they feel comfortable making Nutrition as a part of general education requirement for graduation from college level. Equally however, about **59.2%** % of the **375** college faculty participants also prefer to see Microbiology as a part of the graduation requirement for from college level.

Table 7  
 Total Responses of the College Faculty Participants for College Level Inclusion (N=375)

Total College Faculty Responses for Inclusion of Inquired Subjects at the College Level (N=375)					
Inquired Subject	Prefer to Include at College Level		Prefer not to Include at College Level		Total
	#	%	#	%	
Nutrition	207	55.2%	168	44.8%	375
Microbiology	222	59.2%	153	40.8%	375

In short, as seen in Chart 5, more of all the college faculty participants indicated that they feel more comfortable than less comfortable making Nutrition (**55.2%**) and microbiology (**59.2%**) as a part of general education requirement for graduation from college level.

Chart 5



#### 3.3.2. Total College Faculty Responses for Inclusion of Inquired Subjects at the High School Level (N=350)

Table 8 below shows the overall total responses of all the **370 college faculty** participants in this study in relation to inclusion of the inquired subjects at the high school level. In looking at the overall total responses, while **only 25.33%** of all the college faculty participants indicated that they felt comfortable making Nutrition a part of the

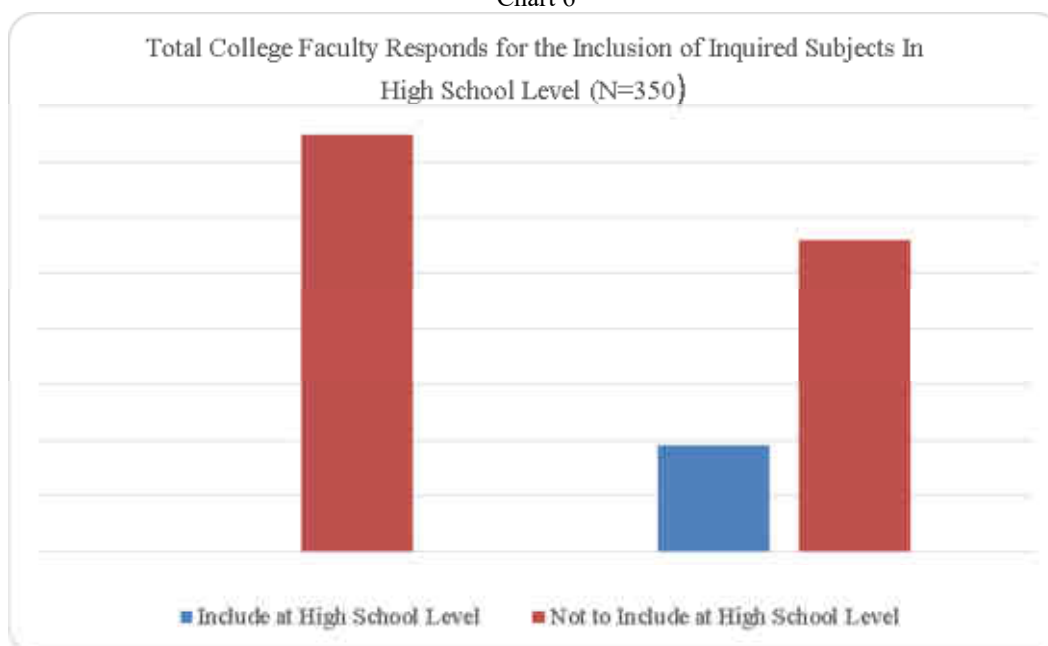


general education requirement for graduation from high school, **none of** all the participants (**0%**) see a need for including Microbiology as a part of the graduation requirement from high school. This means, as seen in Chart 6, **100%** of all the college faculty participants see no need for making Microbiology a graduation requirement from high school; as well, **74.66 %** of the same participants see no need for making Nutrition a part of the graduation requirement from high school.

Table 8  
 Total Responses of the College Faculty Participants for High School Level Inclusion (N=375)

Total College Faculty Responses for Inclusion of Inquired Subjects at the High School Level (N=350)					
Inquired Subject	Prefer to Include at High School Level		Prefer not to Include at High School Level		Total
	#	%	#	%	
Nutrition	95	25.33%	280	74.66%	375
Microbiology	0	0%	375	100%	375

Chart 6



In summary, as seen in Chart 5, almost an equal number of college faculty participants felt comfortable with including Nutrition (55.2%) and Microbiology (59.2%) as graduation requirements from college. On the other hand, as seen in Chart 6, all of the college faculty participants (100%) see no need for Microbiology at the high school level; in addition, 74.66% of the same participants see no need to include Nutrition as a part of the graduation requirements from high school.

Finally, it is important to mention that a total of 26.56% (174) of all the participants (655) see no need for including both subjects together as a part of the graduation requirement from high school and/or college. On the other hands, only 10.5% (69) of the participants (655) see no need for including both subjects together as a part of the graduation requirement from college (Table 9).

### 3.4. Overall Comparison of the Total Responses of All Participants

Table 9 provides an overall comparison of the total responses of all the 655 participants in this study on how they responded to the inclusion of the two inquired subjects at the two educational levels. Note that “Yes” indicates prefer to include, and “No” indicates does not prefer to include the subject in question.

Table 9  
 Overall Comparison of the Total Responses of All Participants\*

Overall Comparison of the Total Responses of All Participants (N=655)					
Inclusion In College Curriculum		Inclusion In High School Curriculum		Total # of All Respondents	
Nutrition	Microbiology	Nutrition	Microbiology		
No	No	No	No	105	16.0%
Yes	Yes	No	No	191	29.2%
Yes	No	No	No	80	12.2%
No	Yes	Yes	No	210	32.1%
No	No	Yes	Yes	69	10.5%
<b>Total</b>				<b>655</b>	<b>100%</b>

\* Note that “Yes” indicates prefer to include, and “No” indicates does not prefer to include the subject in question.

#### 4. Analysis and Discussion

Based on the preceding tabulation of the leading main areas and identified categories (themes) in each question of the study, the analysis delves into explanations of similarities and differences, as well as why these occur. The analysis of the survey feedback and follow-up interviews pointed to a strong agreement among the participants on the significant urgency in doing something to overcome the challenges to the current trends of obesity, diabetes, infectious diseases and other related epidemics among modern societies. There was no disagreement among all the participants on the existence of the problems, and the urgent need to do something to deal with these types of modern health obstacles, issues, and matters. In addition, the majority of the participants see that education, whether formal or informal, could play a major role in helping modern societies overcome these modern health obstacles. However, there is no agreement on how to deal with these issues, and what is the best way forward academically.

The participants also differ on the level of education needed to overcome the health issues facing the world today. A few others see the matter as a socioeconomic-dependent issue, and thus it might be difficult to effectively deal with it systematically through formal education. They argue that in order for formal education to be effective, it must be supported by media, community advocates and policy makers at the city, county, state, and national levels.

Overall, at the college level, while over half of all the participants (61.22%) preferred to see Microbiology as a part of graduation requirement from college, only 41.22% of the same participants felt comfortable in making Nutrition a part of the college graduation requirement. At the high school level, while 42.59% of all the participants saw no problem in including Nutrition as a part of the graduation requirement from high school, only 10.53% of the same participants felt comfortable including Microbiology as a graduation requirement from high school.

Specifically, at a given academic level, the majority of the participants that were high school teachers (65.71%) believed Nutrition should be required for high school graduation. In addition, the majority of these same participants (75.35%) felt Microbiology should not be required for graduation from high school. Yet the majority of these high school teachers (63.92%) supported making this a part of the graduation requirement from college. Lastly, the majority of these high school teachers (77.14%) felt Nutrition should not be required for graduation from college.

On the other hand, the college faculty participants were almost equally divided in their views and beliefs in the inclusion of these inquired subjects at the college level. For example, 55.2% of them felt comfortable including Nutrition as a required subject for graduation, and 59.2% of the same participants felt comfortable in making Microbiology a required subject for graduation from college. When it came to graduation from high school though, none of the college faculty participants felt that Microbiology should be a required course. As well, of these same participants, 74.66% also didn't see a need for including Nutrition as a required course for graduation from high school.

Those participants that supported making Nutrition a mandatory part of general education in high school, and Microbiology a mandatory part of general education in college, believe that exposing students to concepts and principles of nutrition, health, and wellness at the high school level could provide the necessary basic foundation for students to learn about nutrition and the role of nutrients in their daily life. They also argued that students at

the high school level still do not have the needed academic background to really study and understand Microbiology. In addition, many believe that high school curricula is already 'packed' with so many subjects which students must successfully complete before graduation; there is just no 'room' for many more required courses for graduation.

Surprisingly, as seen in Table 9, only 10.5% (69) of all the participants supported making both Nutrition and Microbiology a part of the general education requirement for graduation from high school, but not from college. Those participants believe that since many high school graduates will not go to college, or at least not directly after high school, it is better to help students learn about how to eat a healthy diet and maintain a healthy life style for themselves and their future families in high school; they see that delaying this education and delegating it to the college level may be too late for many. Those participants also go farther with their thoughts of early, proactive education. They indicated that the inclusion of these two subjects at the high school level might be too late, with middle school considered to be an even better option by some participants in our survey. Some of these participants are of the perspective that since Microbiology has become such an important and timely topic in today's age, this is clear and sincere justification for its inclusion in general education; what is more, it unites many concepts in the fields of biology and chemistry that will most likely be a part of their future curricular studies.

Table 9 also shows that about 29.2% (191) of the same participants supported making both Nutrition and Microbiology a part of the general education requirements for graduation from college. Finally, and as shown in Table 9, while 32.1% (210) participants support the inclusion of Microbiology at the college level, and Nutrition at the high school level, about 16% (105) of the same participants see no need to include neither microbiology nor nutrition as a graduation requirement at any educational level. However, we have noticed that more college instructors than high school teachers see little need to make either of these two fields a part of the general education requirement for graduation from either high school or college; but as well, college teachers do look at these two fields differently if this is part of their academic programs.

Participants provided various reasons and justifications for their perspectives. One perspective that exists is the belief that there would be greater success by integrating concepts of nutrition, health, and wellness within every class – whether mathematics, science, language art, sports, history, geography, etc. throughout the curricula of K-12 – thereby helping students become not only familiar with these concepts, but also helping them to adopt effective daily habits for a healthier lifestyle. Making healthy choices includes, but are not limited to, learning not to smoke, eating a balanced diet, exercising regularly, limiting alcohol intake, etc. All these metabolically healthy choices will contribute to reducing the risk for developing heart diseases, strokes and heart failure among people from early ages. They also help our inner microbiomes (human microbial communities) to be biologically sustainable, and maintain a desirable equilibrium/balance (e.g., Perlmutter and Loberg, 2015).

## 5. Final Remarks

The sample population of this study is not large enough to make a generalization. Due to this, a study with a larger sample is needed to note some trends that may not have been observed. Second, a study with participants teaching disciplines other than just science needs to be included in future studies focusing on this same topic. However, the outcomes of this study offer a starting point for generating useful dialogues. As medical doctors, parents, educators, teachers, and college faculty, as well as policy makers, begin to talk, we may start the needed discussion on what to do in regards to the current trend of obesity, diabetes, infectious diseases and other related epidemics among modern societies. The positive key point is that there is agreement among all the participants that the nation is facing critical challenges on overcoming the new trends in obesity, diabetes, infectious diseases and other related epidemics, as well as facing critical challenges in the role of education in solving these matters. The fact that they differ on what to do, and how to prepare the current and future generations of the nation, should not be a distraction from the cause; there are sincere efforts that many teachers, college faculty, as well as parents and health and medical personnel, have been doing to help society overcome the pressing challenges in obesity, diabetes, infectious diseases and other related epidemics.

As seen in Table 9, reviewing the broad perspective, the participants are unequally divided between five main groups. One group (16% or 105) of all participants prefer doing nothing of what the research question proposed. Those participants provided various reasons and justifications for their answers. The second group (29.2% or 191) of all the participants believed in doing something related to the proposed question only at the college level, but not at the high school level. These participants also provided reasons and justifications for their answers in including both Microbiology and Nutrition as part of the requirement only for graduation from college. The third group (32.1% or 210) of all participants believed in doing something related to the proposed question at

both college and high school levels. Those participants provided various reasons and justifications for including Microbiology as a part of the graduation requirement from college, and Nutrition from high school. The fourth group (10.5% or 69) of all the participants believed in doing something related to the proposed question only at the high school level. Those participants provided various reasons and justifications for why both Nutrition and Microbiology should be a graduation requirement for high school. The fifth group (12.2% or 80) of all the participants believed in doing something only with Nutrition, and only at the college level. Those participants provided various reasons and justifications for why including only Nutrition as part of the graduation requirement from college versus the high school level was needed.

Some of those participants who voiced a negative position to the proposed fields of knowledge as being a part of the general education curriculum, indicated that students should not be asked to take any course(s) that is not part of or a prerequisite for, an academic degree program (college level). They explained that this could lead to abusing the intention for financial gain. Some others from the same group were opposed to this based on the grounds that if today we assigned Nutrition and/or Microbiology, more mandatory fields in the future could be proposed. Yet another group said that maybe what we need is not specific field(s) such as Nutrition or Microbiology, but instead selected topics to be introduced in an integrated fashion in some coursework in the high schools or college; rationale for this is supported by the need for all in education to be aware of the ever changing important topics coming into light in this day and age. For example, perhaps we need to look at topics such as geology for the world's climate change, geography and statistics for the explosion in the human population, and chemistry as new pharmaceuticals avail themselves to this ever changing older demographic citizenry.

In short, most, if not all the participants agreed that the world's status is drastically changing in regards to human population, obesity, diabetes, and infectious diseases, all of which are rapidly accelerating at alarming rates with severe consequences. All participants agree that something needs to be done before it is too late. However, the participants did not manage to reach a common consensus as to what to do and how to do it.

The good news is that many of the participants indicated directly or indirectly that they have already been working to make their students aware of these topics; their goal is to empower the students regarding how to make metabolically healthy choices and lifestyles, such as what to eat, and educating students on how food impacts obesity and the type of microbes that grow in human bodies. Our understanding of our microbiome (microbial communities) can widen our knowledge of diseases influenced by these microbial communities living inside our bodies such inflammatory bowel diseases, Parkinson's and even to the prevalence of depression and autism. We can also understand the effects of drugs on our metabolic activities such as the work of cancer drugs or antibiotics (e.g., Perlmutter and Loberg, 2015; Gallagher, 2018).

But the questions remains: Can requiring fields of knowledge as part of a general education mandate, such as Health and Nutrition and/or Microbiology significantly reduce or eliminate the bad eating and lifestyle habits of the population? Is "requiring" academic fields the best approach to this matter? Or is the problem driven by advertising and popular culture, and thus needs to be tackled in a different way? Or is it driven by the shortsightedness of some of our policy and decision makers who are entrusted with the overall health of our nation and the wellbeing of its citizens?

All the participants do agree the problem is a serious one and worth addressing, but are not sure if requiring academic courses would be a good way to combat this problem. A few of them suggested the solution might be in redesigning existing courses and content, more importantly by adding topics that are relevant and significant to the students well-being and health. This would be valuable additions to existing curriculum.

The crucial aim for this paper is the realization that we need to look seriously at the educational community; always looking at paradigm shifts in our global society of humankind, one must realize that perhaps education needs to be looked at much more closely in these modern times. Education is the critically needed tool for empowering students. It can help them attain the knowledge of their own human development, health and inner microbiomes. This knowledge is needed to prepare our students to become global citizens that can not only think critically about the world, but also lead a healthy lifestyle. Peter Salovey (2018), from Yale University, recently argued, "knowledge is power, but only if individuals are able to analyze and compare information against their personal beliefs, are willing to champion data-driven decision making over ideology, and have access to a wealth of research findings to inform policy discussions and decisions"(p. 11). Even though there are more people completing k-12 education than college education, is our higher education, through colleges and universities, in a better place than our K-12 system to champion endeavors such as this? Let the dialogue start to find the suitable

knowledge and the better approach to educate the future generation of the global citizens about important health questions. Students need to learn how to stop diabetes before it starts, to prevent obesity and avoid a sedentary lifestyle which are the biggest risk factor for diabetes. They need to learn the importance of our food intake on some health issues and the interaction of food with some drugs. Why we should avoid, for example, grapefruit and grapefruit juice if we are taking certain statins for high cholesterol, why we should avoid too much calcium if we are taking certain heart medicines or why we should avoid fish oil supplements if we are taking blood thinner. To learn why it is not the amount of calories we consume, but the type and quality of the calories that really matter, or just simply counting calories and cutting down on what we eat is not enough (e.g., Roberts, 2018). These were a few of many important metabolic questions that impact our health and future.

The human microbial communities which are acquired at birth can be influenced by many things including life style, genetic traits, medical history and dietary habits. Factors such as these, collectively or individually, can largely impact one's own energy metabolism, individual behavior and overall health. Learning about the microbial communities in the human body, and the role they play in sustaining life and living, can be achieved by learning and understanding. All in all, the important point here is to never lose sight of how crucial these microscopic entities are to the world we as humans live in. They were here long before we were, and are definite effectors in humankind's continued existence.

In concluding this paper, we feel that there is perhaps one larger issue at stake here with the education of our citizenry in the domains of nutrition and microbiology. These concepts need to be fully looked at and understood, for they may be the harbingers of looming problems in many countries. As we discussed in the Introduction of this paper, health issues are directly related to key concepts found in microbiology and nutrition courses. In the United States we are clearly not availing ourselves to practices that lead to our overall health and welfare. The dialogue needs to start now. Within that discourse, educators and instructors in all countries can share what is working in their respective educational systems to support their respective citizenries in their health and welfare specifically. This is probably the ultimate need for a paper such as this--- to start the discussions, to propel new ideas and paradigm shifts, especially as we see the truly decline in aspect of the health of our American citizenry. A discussion with educators in other countries about the importance of educating their populations in regards to nutrition and microbiological concepts is a good beginning. Knowledge is power and elicits change. Thus, we offer this paper as the initiator for a change and a forward propulsion for the good of humankind; as we open our eyes to other countries and see differences and similarities in the education of healthy life style choices, we make a stronger global citizenry that is well, in spirit and body.

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## Appendixes:

### Appendix 1: General Education

The term general education refers to a component of an undergraduate liberal-arts and sciences education designed to provide a broadening and a foundational base for the more focused, typically higher-level courses known as the major within a Bachelor of Arts or sciences program as well as knowledge and skills for enhancing personal life and living. The design aspect of general education includes required selection of courses from four primary higher education areas: humanities, social sciences, natural sciences, and math. In addition, written and oral communication are commonly part of the requirements that may also be subject to state higher education board specifications. Prescription of specific courses, however, is not the basis of the general education design; rather, students are free to choose elective courses within the required categories.

By teaching essential skills, such as critical thinking, and academic skills such as writing and research, general education prepares students for more focused study at advanced levels. By providing insight into a broader range of disciplines, along with their methods and assumptions, general education also prepares students to pursue their major studies in a broader educational context. And finally, general education provides students with skills and competencies designed to serve them well beyond graduation, establishing them as life-long learners and informed citizens. General education has gained additional and new value of (the need for) new kinds of knowledge which assumed greater importance in recent times when the health of the American public has been degraded by poor diet, lack of exercise, sedentary lifestyles etc. Along with promoting such knowledge in the curriculum, the inclusion of "gym" courses (swimming, volleyball, tennis, gymnastics, etc.) in the spectrum of requirements is desirable.

Appendix 2: Understanding Diabetes

Understanding Diabetes				
		Prediabetes	Type 1 Diabetes	Type 2 Diabetes
1	Risk Factors	<ul style="list-style-type: none"> <li>• Sedentary lifestyle</li> <li>• Obesity</li> <li>• Large waist size</li> <li>• Poor diet</li> <li>• Age</li> <li>• Family history</li> </ul>	Not entirely clear, but genetically is a major risk factor. Type 1 diabetes is commonly diagnosed in children	Same as prediabetes
2	Symptoms	No obvious symptoms	<ul style="list-style-type: none"> <li>• Increased hunger</li> <li>• Increased thirst</li> <li>• Frequent urination</li> <li>• Fatigue</li> <li>• Weight loss</li> <li>• Blurred vision</li> <li>• Mood changes</li> </ul>	<ul style="list-style-type: none"> <li>• Largely the same as with type 1 diabetes</li> <li>• Slow-healing sores</li> <li>• Darkened skin on some areas of the body</li> </ul>
3	Treatments	<ul style="list-style-type: none"> <li>• Lose weight</li> <li>• Eat more fruits, vegetables and whole grains</li> <li>• Engage in 150 minutes moderate aerobic exercise per week</li> </ul>	<ul style="list-style-type: none"> <li>• Insulin therapy</li> <li>• Patient may need to check blood sugar levels multiple times a day.</li> <li>• Low-fat, high-fiber diet; monitor carbs</li> <li>• Exercise</li> </ul>	<ul style="list-style-type: none"> <li>• Improve your diet</li> <li>• Lose weight</li> <li>• Exercise</li> <li>• Monitor your blood sugar</li> <li>• Insulin (for some)</li> </ul>

*Source: The Mayo Clinic, the American Diabetes Association (Budd, 2018, p. 30)*