

Diet, Microbiome, and Neurological Diseases

A Major Qualifying Project

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PROJECT DESCRIPTION(S)

This Major Qualifying Project (MQP) was completed to satisfy the requirements of both the Biochemistry degree and the Professional Writing degree. The primary purpose was to combine an authentic scientific research project conducted on gut microbiome and neurological disorders together with an analysis of written popular media on dietary supplement use. To complete this combined MQP, I conducted the scientific research portion at the University of Massachusetts Medical School (UMMS), under the advice of Professor Mark Alkema (UMMS), Dr. Wookyu Kang (UMMS), and Professor Carissa Olsen (WPI). Simultaneously, I conducted the literature analysis portion under the guidance of Professor Brenton Faber. This practice in science and communication was a meaningful study to understand both the technical and humanities disciplines within the context of the other.

This full MQP report is a compilation of all of the work done for both majors. The first chapter contains the scientific research portion of the study conducted in the laboratory. The second chapter consists of the entirety of the literature analysis portion of the project on dietary supplement use. Finally, the report concludes with a reflection on the overall educational experience, having immersed in both the scientific and rhetorical aspect of an exciting new research on gut-brain communication.

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I would like to express my deepest appreciation to the following individuals, without whom I could not have completed my project:

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The Biochemistry and Professional Writing departments, for their allowance of my combined MQP. I cannot express how much growth I have acquired from this experience and I could not have otherwise not have obtained.

CHAPTER ONE

The Effects of Gut Microbiota on Neurological Disorders

ABSTRACT

Recent research shows that the gut microbiota plays a key role in preventing neurological diseases. However, the molecular basis of the complex interaction of diet, microbiota, and the brain is poorly understood, because of the complexity of both mammalian microbiome and nervous system. In this research, we tested the effects of various bacteria on behavior and axonal health of the *Caenorhabditis elegans* model systems for neurological disorders. We found that *Bacillus* and *Comamonas* diets can suppress clonic seizure behaviors, spontaneous convulsive behaviors, and possibly slow axonal degeneration. Given the strong conservation of metabolism and neural function between *C. elegans* and humans, these studies can ultimately inform the use of probiotics that improve the condition of patients suffering from neurological disorders.

BACKGROUND

A study done in 2011 showed that approximately 100 million people in America has suffered from at least one of the over 1000 neurological diseases (Gooch et al., 2017). The ability for diet and gut microbiota to communicate with the brain has resulted in an emergence of an exciting new concept in health and disease. In humans, recent links have been drawn between the gut microbiome and neurological diseases such as depression, migraine, anxiety, autism, schizophrenia, and neurodegenerative disorders (Gomez-Pinilla, 2008, Noble et al., 2017, Proctor et al., 2017). However, the molecular basis of the complex interaction of diet, microbiota, and the brain is poorly understood. Because of the complexity of both mammalian microbiome and nervous system, studying the molecular basis has been difficult. The understanding of the intricate network of signaling pathways from the gastrointestinal tract and the central nervous system is important as it could result in a promising treatment or prevention of neurological diseases.

The nematode *Caenorhabditis elegans* has been an important model organism to understand basic mechanisms of neural development, synaptic transmission, and sensory processing. These processes have been highly conserved from worm to man and thus have provided useful information on human brain function and diseases. Because of its known neural connectivity (White et al., 1986), and the ease of forward and reverse genetic analysis, *C. elegans* has been a valuable model for human neurological disorders such as Alzheimer's disease, migraine headaches, and Parkinson's disease (Kang et al., unpublished). For this study, we used three different *C. elegans* model for neurological disorders, migraine, epilepsy, and neurodegenerative diseases.

C. elegans model for Familial Hemiplegic Migraine

C. elegans has a single $\alpha 1$ subunit in its P/Q-type voltage-gated calcium channels ($Ca_v2\alpha$) which is encoded by the *unc-2* gene (Schafer WR & Kenyo CJ, 1995). *C. elegans* with a loss of function mutation on the *unc-2/Ca_v2\alpha* gene are known to be uncoordinated and sluggish due to the decreased neurotransmitter release at the neuromuscular junction (Mathews et al., 2003, Richmond et al., 1999). The Alkema lab has previously done a behavioral genetic screen where they identified an *unc-2/Ca_v2\alpha* gain of function allele (G113R, Figure 1) and saw a clonic seizure behavior characterized by dramatic increase in the number of reversals as shown in Figure 2A (Huang and Alkema, in preparation). This meant that the worms continuously reversed its direction and locomotion. Moreover, the *unc-2/Ca_v2\alpha(gf)* mutants are hypersensitive to the acetylcholine esterase inhibitor aldicarb due to the increase in the neurotransmitter release as shown in Figure 2B.

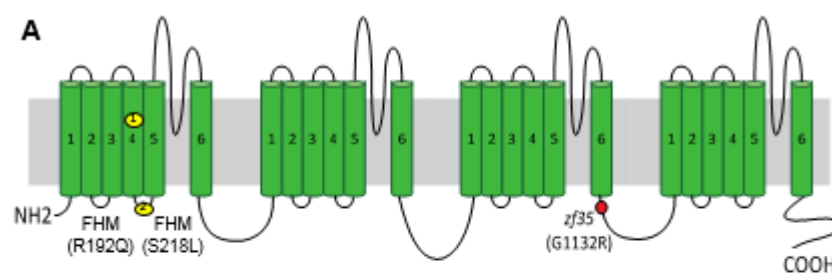


Figure 1. UNC-2/CaV2 protein structure. Green: transmembrane domains; Red: UNC-2/CaV2 GF mutation; Yellow: *FHM1* GF mutations.

Interestingly, similar changes were observed with the gain-of-function mutations S218L and R192Q in human *CACNA1A*, which are linked to Familial Hemiplegic Migraine (FHM-type I) (Hans et al., 1999). The Alkema lab has also previously shown that a transgenic worm that express the FHM1 R192Q and S218L mutation has resulted in clonic seizure behavior as shown in Figure 2A, and had hypersensitivity to aldicarb as shown in Figure 2B, just like the *unc-2/Ca_v2 α (gf)* mutants. From these results it was shown that the molecular functions in the *unc-2/Ca_v2 α* and the *CACNA1A* are highly conserved from worms to humans and it serves as a valuable model for *in vivo* study of the Familial Hemiplegic Migraines in humans (Alkema et al, unpublished).

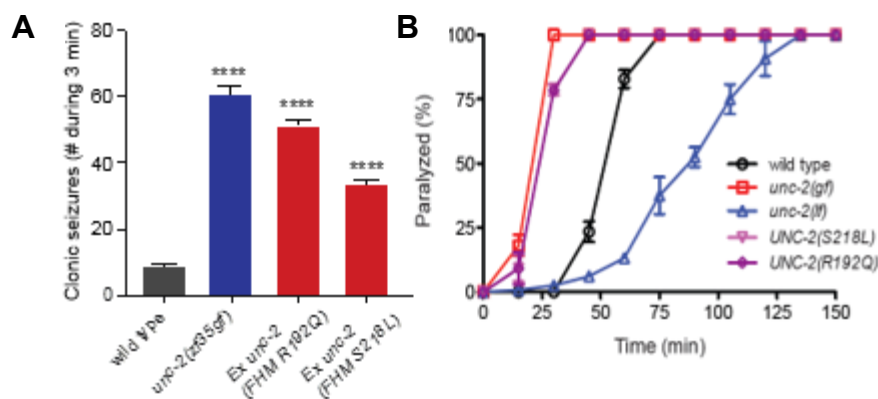


Figure 2. Human FHM1 mutations in the *unc-2* gene result in (A) a clonic seizure phenotype and (B) increased neurotransmission in worms (Alkema et al., unpublished).

C. elegans model for Epilepsy

ACR-2 is an acetylcholine receptor subunit expressed in neurons. *C. elegans* with a loss of function mutation on the ACR-2 receptor display a slightly sluggish locomotion due to a decrease in cholinergic motor neuron activity. On the other hand, a gain-of-function mutation in ACR-2 results in a hyper-activation of cholinergic neurons, displaying a spontaneous muscle convulsive behavior (Jospin et al., 2009). This gain-of-function mutation in ACR-2 changes a valine to methionine at the 13 position in the pore-forming transmembrane domain of the ACR-2 subunit, which is highly conserved in acetylcholine receptors.

Interestingly, in humans, multiple mutations in the acetylcholine receptor subunits that are encoded by *CHRNA2* (α 2), *CHRNA4* (α 4), and *CHRNB2* (β 4), have shown to have links to autosomal dominant forms of epilepsy (Boillot & Baulac, 2016). It is also known that the V13M mutation in mammalian neuronal acetylcholine receptors are associated with epilepsy (Stawicki et al., 2011).

C. elegans model for Neurodegenerative Diseases

The *mec-4* gene encodes an epithelial Na⁺ channel protein required to sense gentle mechanical stimuli along the body wall in *C. elegans* (WormBase). A *C. elegans* that has neurotoxic changes in the *mec-4d* channel has a large side chain amino acid substitution that happens adjacent to or part of the channel pore (A713V or A713T) (Bianchi et al., 2004). Figure 3 shows the location of the *mec-4* channel in *C. elegans*. The hyper-activation of *C. elegans*' MEC-4 DEG/ENaC sodium channel induces neuronal necrosis through the increase of intracellular Ca²⁺. The increase in the intracellular Ca²⁺ plays an important role in inducing apoptosis and necrosis, and has been shown to contribute to neuronal damages that lead to neurodegenerative diseases. The axonal degeneration in *C. elegans* with the *mec-4d* mutation is an ideal model for the neurodegenerative disease and neuronal dysfunction because it is continuously degenerating due to its hyper active *mec-4d* channel.

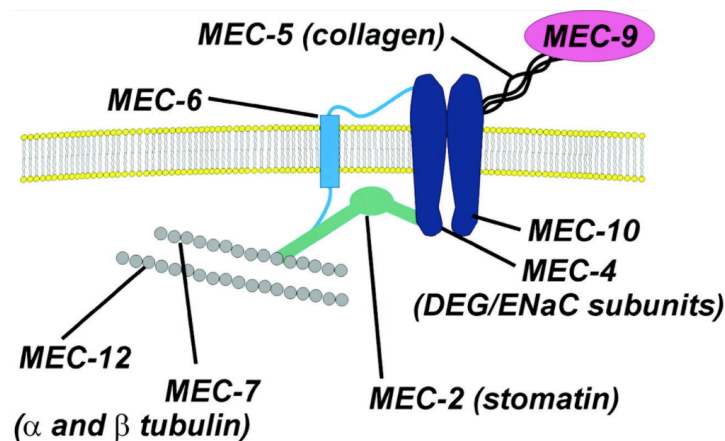


Figure 3. Model of mechanosensory ion channels in *C. elegans* (Strange, 2003)

Bacterial Nitric Oxide affects C. elegans Lifespan

Nitric oxide (NO) is known to play important roles in living organisms by modulating the activities of various proteins either directly by binding to their active centers or indirectly by post translationally modifying specific redox active thiols and other amino acid residues (Gusarov, 2013). Nitric oxide is an important signaling molecule in the brain that can diffuse across cell membranes between cerebral blood vessels, neurons and glial cells (Bagdy et al., 2010, Hanafy KA et al., 2001, Thomas DD et al., 2008). Nitric oxide plays a key role in normal brain function as well as a variety of neurological disorders including depression, schizophrenia, neurodegenerative diseases as well as migraine headaches (Steinert JR et al., 2010, Neeb L & Reuter U, 2007, Olesen J, 2008).

Although *C. elegans* do not contain the gene that encodes for nitric oxide synthase gene, *C. elegans* lives mostly on decomposing plant material where bacteria such as *Bacillus subtilis* and other soil bacteria, including *Staphylococci* and *Streptomycies*, that synthesize NO via the NO synthase as shown in Figure 4. Nitric oxide greatly influences brain function and mental health in *C. elegans*. A study conducted by Gusarov et al., has shown that *C. elegans*' lifespan and stress resistance can be increased through NO derived from bacteria and in the Alkema lab, it was seen that *Bacillus*, a NO synthesizing bacteria reduced reversal frequency of the *unc-2/Ca_v2α(gf)* model. In this study, we will investigate the effects of NO on necrosis through the use of a *mec-4d* worm model.

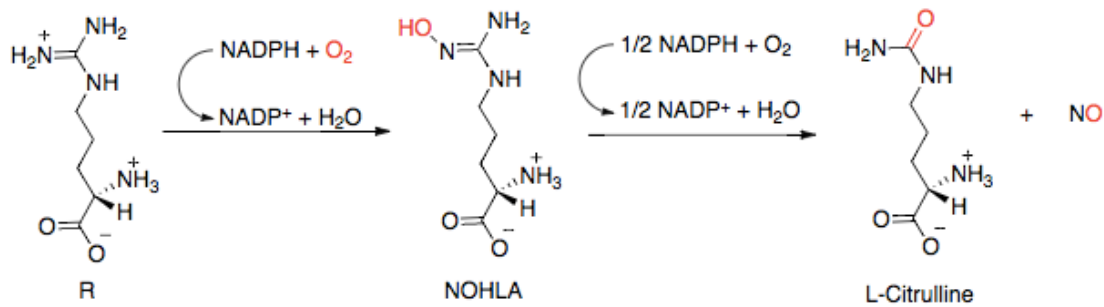


Figure 4. Synthesis of NO via the NO synthase

METHODOLOGY

Behavior analysis of *unc-2/Ca_v2α(gf)* *C. elegans* on various bacterial diets

Young adult *unc-2/Ca_v2α(gf)* worms were transferred on an OP50 *E. coli* standard diet for 4 hours in order to let the worms lay eggs. After 4 hours, the worms were removed and discarded. The plates with the eggs were left for two days at room temperature for the worms to reach the L4 growth stage. Once the worms had become L4s, >40 worms were transferred to various bacterial strain diets, *Pseudomonas*, *Enterobacter*, *Providencia*, *Leucobacter*, *Buttiauxella*, *Bacillus*, *Comamonas*, and *Gluconobacter*. A control experiment that used OP50 *E. coli* standard diet was also performed for each trial. The worms were left for one day at room temperature before the behavior was analyzed.

To analyze reversal frequency, a behavior plate made with medium agar plates and a thin lawn of OP50 *E. coli* was created the night before. For each trial, 20 worms were transferred into a small-unseeded agar plate to remove the bacterial diet from the worms. This is to avoid any chunks of bacteria transferring onto the behavior plate, which affects the reversal frequency, as the worms tend to stay closer to locations where there is a large amount of food. Once the food was removed, the 20 worms were transferred onto the behavior plates and analyzed on a multi-worm tracker. Before the plates were placed on the tracker, the plates were tapped on the table so that the worms will start moving. The behavior was tracked for five minutes allowing the worms to get used to the new environment and the number of reversals were analyzed during the last three minutes using a Matlab analysis tool.

Behavior analysis of *acr-2(gf)* *C. elegans* on various bacterial diets

Before behavior screening took place, >10 L4 *acr-2(gf)* worms were transferred to various bacterial strain diets, *Bacillus*, *Comamonas*, *Acetobacter*, and an OP50 *E. coli* standard diet control. The worms were left for one day prior to behavioral analysis.

To analyze behavior, a behavior plate made with medium agar plates and a thin lawn of OP50 *E. coli* was created the night before. For each trial, one worm was transferred to the behavior plate, then left for 2 minutes. After 2 minutes, the worm was scored for convulsion for 90seconds under a microscope.

Neural degeneration of *Mec-4d C. elegans* on various bacterial diets and the effects of nitric oxide on the neural degeneration of *Mec-4d C. elegans*

To investigate the effects of *Bacillus*, *Comamonas*, and *Acetobacter* on neural degeneration, two to three young adult worms of wild type and *mec-4d* mutant animals, expressing GFP under *mec-4* promoter to assess the AVM neuron morphologically, from the OP50 *E. coli* plates were transferred to three small agar plates containing *Bacillus*, *Comamonas*, *Acetobacter*, T10 *E. coli*, T10 *E. coli* with added nitric oxide, and *Bacillus* with a mutation that would not produce nitric oxide. These worms were left at room temperature to grow and reproduce for at least two generations without it starving. After it was grown for at least two generations, the worms at the L4 growth stage were screened for neuronal degeneration.

To monitor the axonal morphology of AVM neuron, a microscope slide was made using a small amount of agar on a glass microscope slide. Approximately 2 μ L of 100nM sodium azide was placed on the agar so that the worms will be paralyzed once it is on the slide. Worms of the L4 growth stage was then transferred onto the microscope slide where the sodium azide was placed. After two to three minutes, the worms will be fully paralyzed and can be screened using a fluorescent microscope. The axonal degeneration and neuronal loss in the AVM neuron arises post embryonically and the degeneration process can be observed from the beginning (Calixto et al., 2012). The images of the AVM neurons were taken and its morphology was scored according to the morphological category as outlined by Calixto et al; Axon Wild-type (AxW), Axon Beaded (AxB), Axon Truncated (AxT), and no Axon (Ax0).

RESULTS

Bacterial diet affects *C. elegans* clonic seizure behavior

Figure 5 shows the results of the behavior analysis on the *unc-2/Ca_v2α(gf)* mutants grown on 9 different genera that were beneficial and support *C. elegans* growth (Samuel BS et al., 2016). To examine the effect of various bacterial diets on the clonic seizure behavior of *unc-2/Ca_v2α(gf)* mutants, animals were raised on a laboratory standard *E. coli* OP50 diet till the late 4th larval stage (L4) after which they were transferred onto plates containing different bacterial diets. The formation of *C. elegans* nervous system is completed at the L4 stage, therefore, this approach avoids potential impacts of diet on neuronal development.

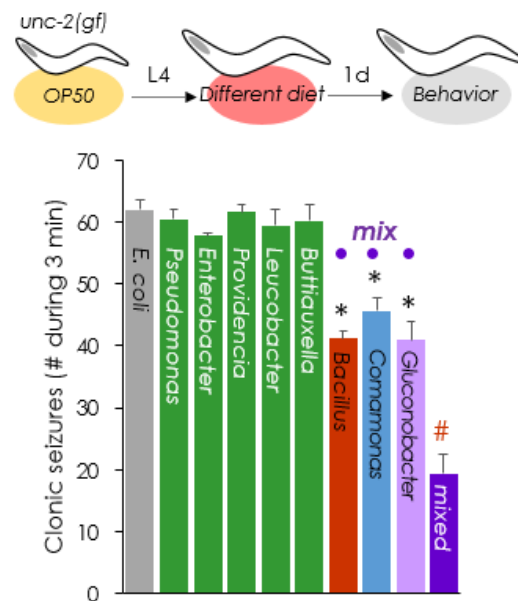


Figure 5. The behavioral hyperactivity of *unc-2/Ca_v2α(gf)* mutants can be suppressed by bacterial diets. (Kang et al., unpublished)

The results show that three bacterial strains, *Bacillus*, *Comamonas*, and *Gluconobacter* has significantly reduced the clonic seizure behaviors of *unc-2/Ca_v2α(gf)* mutants (Figure 5). Wild-type animals grow and develop normally on *Bacillus*, *Comamonas*, and *Gluconobacter* and display no obvious behavioral differences (data not shown). Interestingly, a mixture of the three bacteria has showed a synergistic effect in that the clonic seizure behavior was reduced significantly close to the wild type levels. This indicates that these bacterial strains act through independent mechanisms to suppress seizure phenotype of *unc-2/Ca_v2α(gf)* mutants.

Bacterial diet affects *C. elegans* spontaneous convulsion behavior

Figure 6 shows the results of the behavior analysis on the *acr-2(gf)* worms grown on three different bacteria, *Bacillus*, *Comamonas*, and *Acetobacter*. To examine the effects of bacterial diet on the convulsive behavior of *acr-2(gf)* mutants, animals were raised on a laboratory standard *E. coli* OP50 diet till the L4 stage after which they were transferred onto plates containing different bacterial diets. The formation of *C. elegans* nervous system is completed at the L4 stage, therefore, this approach avoids potential impacts of diet on neuronal development.

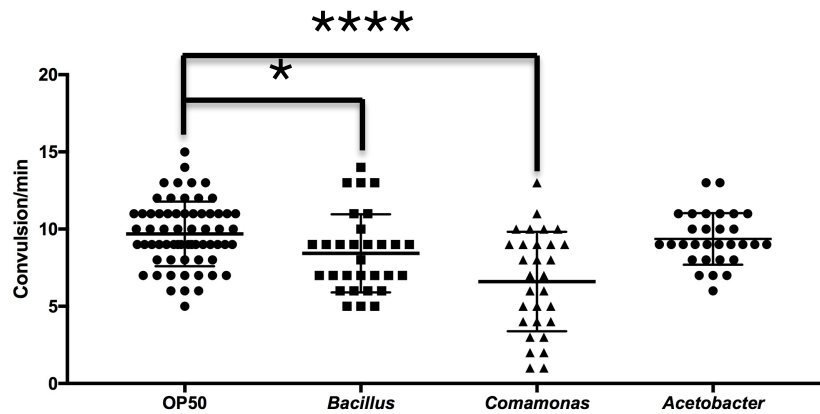


Figure 6. The convulsive behavior of *acr-2(gf)* mutants measured per minute can be suppressed by bacterial diets. One-way ANOVA analysis was done with n=30 animals.

The results show that there was a significant decrease in convulsion in the worms that were grown on *Bacillus* and *Comamonas*. On average, a worm grown on a standard OP50 diet would display approximately 10 convulsions per minute, however, as shown above, the worms that were grown on *Bacillus* displayed ~8 convulsions per minute and the worms grown on *Comamonas* displayed ~6 convulsions per minute. This significant decrease suggests that both *Bacillus* and *Comamonas* was able to suppress the convulsive behavior thus providing possible benefits to the worms.

Neurodegeneration of Mec-4d *C. elegans* on various bacterial diets

Figure 8 shows the results of the neural degeneration of the AVM axons in OP50, *Bacillus*, *Comamonas*, and *Acetobacter*. To examine the effects of bacterial diet on neurodegeneration, animals were raised on different bacterial diets for at least 2 generations till the L4 stage before imaging. Since the formation of AVM axons in *C. elegans* begins from L1 stage, approximately 10 hours after hatching (Sulston & Horvitz, 1977), this approach avoided any potential impacts of previous diet on AVM axonal development. After imaging, the animals were categorized according to morphological categories as outlined in Figure 7.

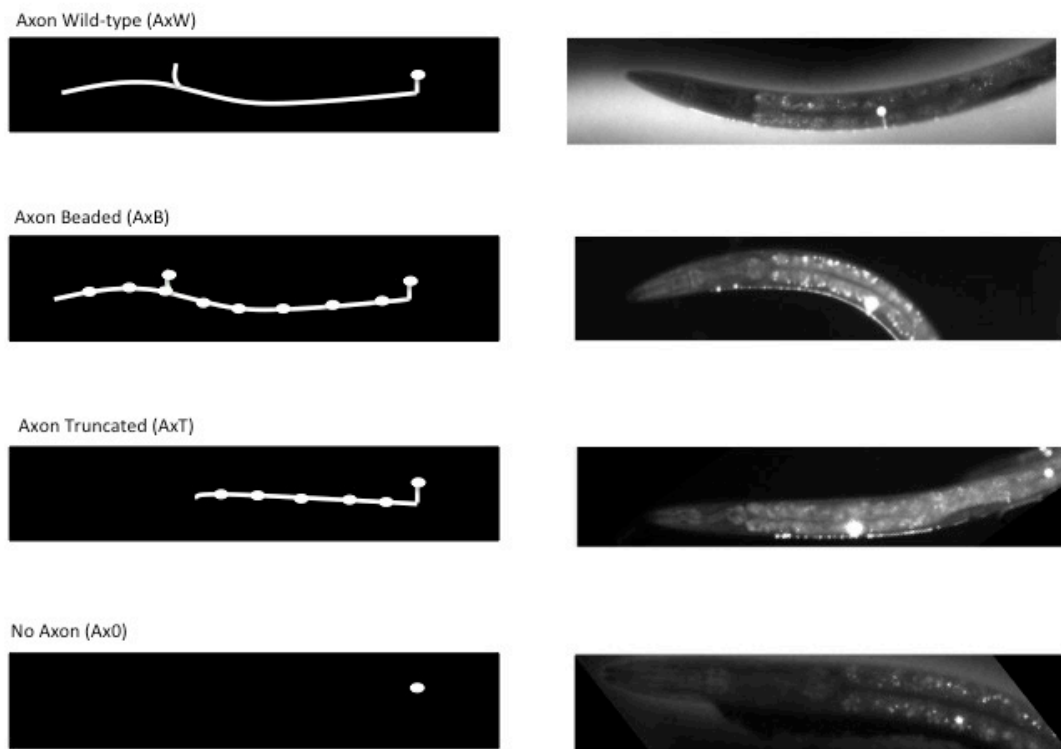


Figure 7: AVM Axon Morphology of L4 worms. Axon Wild-Type (AxW) have no beads on the axon; Axon Beaded (AxB) have beads on the axon but no truncation of the axon; Axon Truncated (AxT) have shorter axon and beading; No Axon (AX0) shows no axon at all and just the soma.

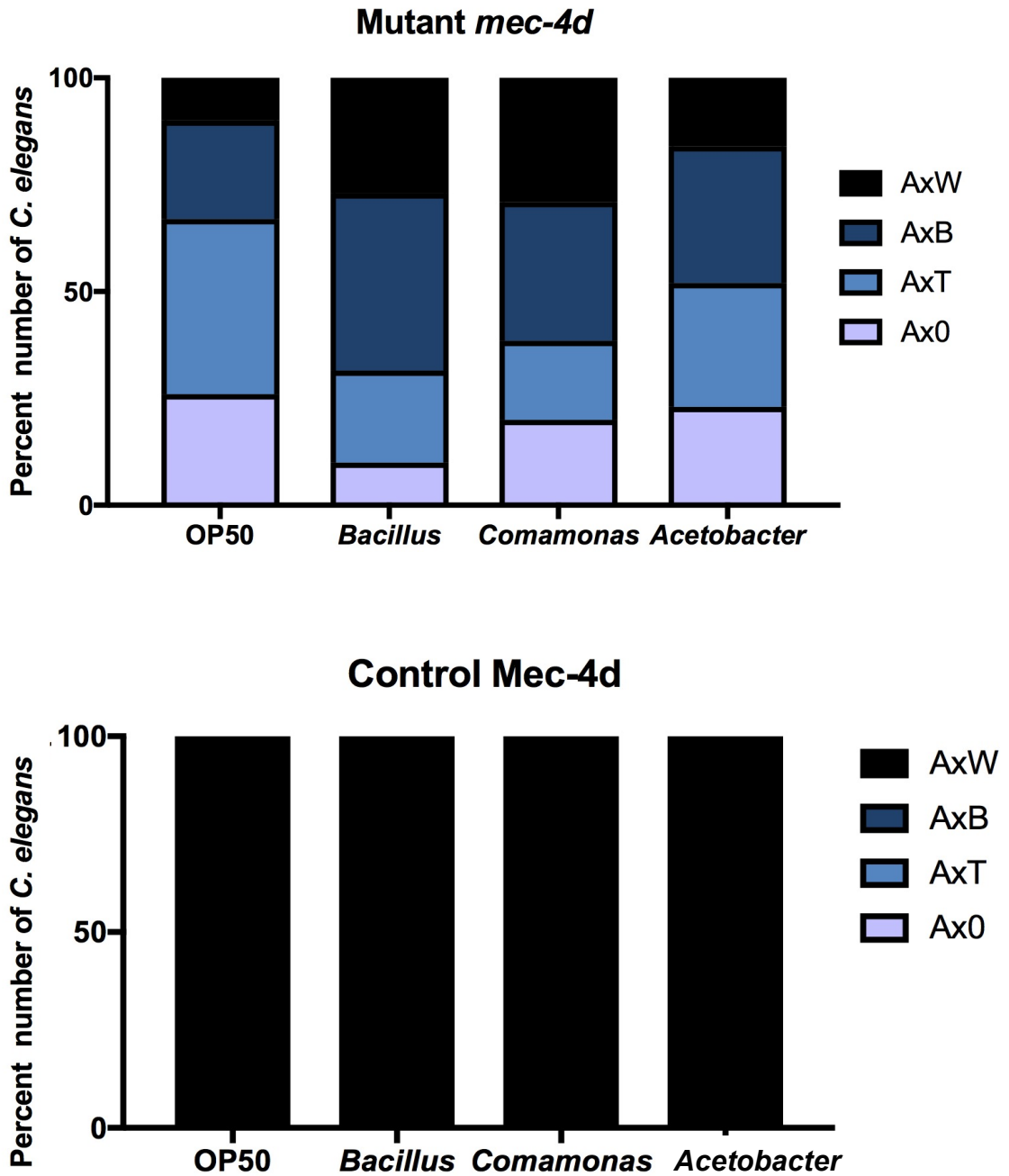


Figure 8: AVM Axon Morphology of L4 worms grown in *Bacillus* (n=70), *Comamonas* (n=70), and *Acetobacter* (n=30)

As Figure 8 shows, the axonal health of the L4 worms that are grown in *Bacillus*, *Comamonas*, and *Acetobacter* may have been improved as compared to the worms in the OP50 diet. For *Bacillus*, approximately over 50% of the axons on the L4 worms are either AxW or AxB with the least number of worms in the Ax0 category. *Comamonas* also showed over 50% of the axons in the AxW and AxB category. Lastly, *Acetobacter's* data had a less of a promising result because the number of worms that were in the AxW category stayed relatively similar to the control OP50 group.

The effects of nitric oxide on the neurodegeneration of *mec-4d* *C. elegans*

Nitric oxide is an excellent candidate metabolite to reduce the neurodegeneration, because *Bacillus*, in contrast to *E. coli*, produces nitric oxide. Thus, we examined the effects of nitric oxide on neurodegeneration by raising the animals in *Bacillus* that is deficient in nitric oxide, and *E. coli* that has added nitric oxide. Figure 9 shows the results of the neural degeneration of the AVM axons in *Bacillus*, *E. coli*+NOS and NOS- *Bacillus*.

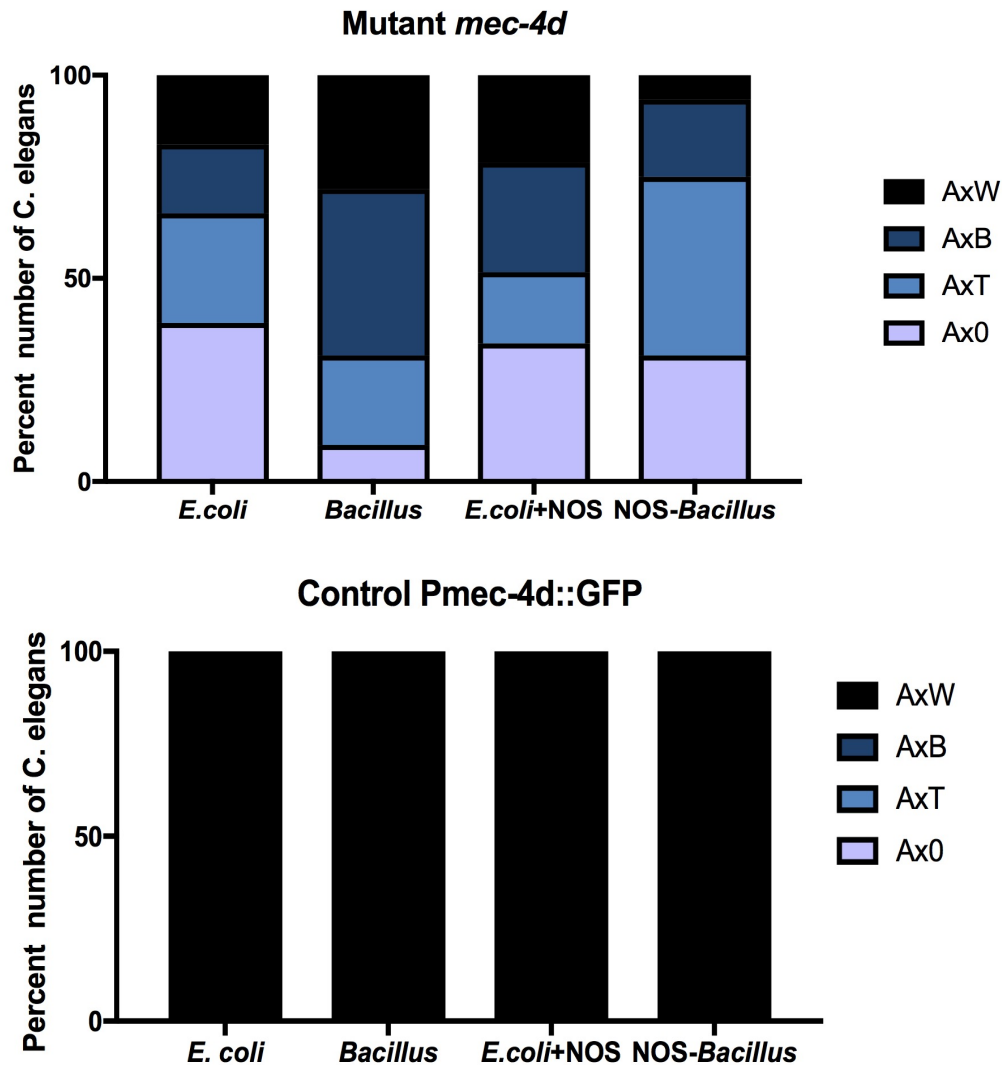


Figure 9: AVM Axon Morphology of L4 worms grown in *E. coli* (n=70), *Bacillus* (n=70), *E. coli* +NOS (n=70), and NOS-*Bacillus* (n=50)

As Figure 9 shows, the worms grown on *Bacillus* have mostly beaded or wild type AVM axons, which compared to the NOS deficient *Bacillus*, there are more worms that had truncated or no axons. Compared to the NOS deficient *Bacillus*, the *E. coli* with added nitric oxide shows that there are around 50% of worms that have wild type and beaded axons, and 50% truncated axons and no axons. Although a decrease in the number of worms with truncated or no axons can be observed, compared to nitric oxide deficient *Bacillus*, there was no significant difference in neurodegeneration between the diets containing nitric oxide and the diets that are deficient of nitric oxide.

DISCUSSION AND FUTURE DIRECTIONS

Using the three *C. elegans* model for neurological disorders, one for migraines (*unc-2/Ca_v2 α (gf)*), one for epilepsy (*acr-2(gf)*), and another for neurodegenerative diseases (*mec-4d*), a few conclusions can be drawn:

1. *Comamonas*, *Bacillus*, and *Gluconobacter* can significantly decrease clonic seizure behavior in the *unc-2/Ca_v2 α (gf)* mutant animals, suggesting a possible benefit of these diet to patients with migraines.
2. *Comamonas*, and *Bacillus* can significantly decrease convulsive behavior in *acr-2(gf)* mutant animals, suggesting a possible benefit of these diet to patients with epilepsy.
3. *Comamonas*, *Bacillus*, and nitric oxide produced by *Bacillus* can reduce axonal degeneration caused by the *mec-4d* mutation, although more data is needed to be statistically significant.

Given the strong conservation of metabolism and neural processes from worm to man, these studies will provide valuable insight into the gut-brain axis. Ultimately, we aim to identify novel dietary and probiotic treatments of disabling migraines and other neurological disorders.

The Effects of *Comamonas* diet on neurological disorders:

Comamonas is known to produce vitamin B12 whereas *E. coli* is known to produce very little vitamin B12 (Watson et al., 2014). Since *Comamonas* was able to significantly decrease the convulsive behavior as shown in Figure 6, a question of whether vitamin B12 is the metabolite that decreases convulsion arises. In order to test this effect, a behavioral analysis of the *acr-2(gf)* grown on vitamin B12 deficient *Comamonas* and *E. coli* with added vitamin B12 should be conducted.

Additionally, it was shown in Figure 7 that *Comamonas* might be able to prevent axonal degeneration. Since there was no significant difference between the rate of neurodegeneration in animals raised on an *E. coli* diet and *Comamonas*, more data is needed to confirm this hypothesis. However, if *Comamonas* does indeed decrease the rate of axonal degeneration, vitamin B12 may be the metabolite that is involved in decreasing neurodegeneration. In order to identify whether vitamin B12 is slowing neurodegeneration, similar experiments will be done where animals will be grown on various bacterial diets, but with B12 deficient *Comamonas* and *E. coli* with added vitamin B12. If vitamin B12 is the metabolite that is preventing axonal degeneration, *E. coli* with added vitamin B12, but not B12 deficient *Comamonas*, would show similar effect as *Comamonas*.

The Effect of *Bacillus* diet on neurological disorders:

Because *Bacillus* has an ability to produce nitric oxide, nitric oxide may be the metabolite that was decreasing the convulsive behaviors in the *acr-2(gf)* worms as shown in Figure 5. In order to better understand the effects of nitric oxide, there will be a need to do experiments with *E. coli* that has added nitric oxide, and nitric oxide deficient *Bacillus*.

In regards to the effects of nitric oxide on neurodegeneration, as shown in Figure 7, it can be seen that compared to the nitric oxide deficient *Bacillus*, there were more worms that did not have any axons in the worms that were grown in *E. coli* and nitric oxide. There was a decrease in the number of truncated axons in the *E. coli* with added nitric oxide, compared to nitric oxide deficient *Bacillus*, but more data is needed to confirm this trend. A possibility that the *E. coli* with added nitric oxide may not have similar effects as *Bacillus* could be that since nitric oxide is very unstable and volatile, a sufficient amount of it may not have been delivered to the worms. In order to prevent that, fresh plates should be made the night before the experiment so that the nitric oxide is not lost during the experiments.

After data regarding nitric oxide has been confirmed, determining the major target for guanylyl cyclase could possibly be found. Because of nitric oxide's unique chemical properties, a small, short-lived, and pervasive free radical, it allows for it to act as a signaling molecule by freely diffusing across cellular compartments and membranes and activating soluble guanylyl cyclase, a heterodimeric enzyme (Gusarov et al.). Guanylyl cyclase converts guanosine triphosphate (GTP) to cyclic guanosine monophosphate (cGMP) an important component of the signaling pathway relating to smooth muscle relaxation and neurotransmission (Denninger and Marletta, 1999). Given that soluble guanylyl cyclase (sGC) are the major targets for nitric oxide in mammals, determining the sGC genes needed for axonal degeneration is important. *C. elegans* encode seven sGC but it does not encode nitric oxide synthase (Cheung, 2004). Because it cannot produce its own nitric oxide, it receives its entire nitric oxide source from its food. Thus using a *C. elegans* model to determine the target sGC would be an effective way to determine which of the sGC is involved in nitric oxide action on neurodegeneration.

Other possible hypothesis that could be derived from this data is that there may be another metabolite being produced by *Bacillus*, which may be synergistically working with nitric oxide, reducing the rate of axonal degeneration. In order to test whether *Bacillus* is able to produce other compounds, there will be a need to genetically screen *Bacillus* and compare it to *E. coli* to see if there are some metabolites that may be produced more in *Bacillus* as opposed to *E. coli*.

CHAPTER TWO

Dietary Supplement Use: Public Perception and Understanding, 2007 to 2016

ABSTRACT

This project, conducted simultaneously with my BC MQP, examined the public perception and understanding of dietary supplements from the years 2007 to 2016. The public presentation of scientific research will influence how science is adopted and used by the general public and whether or not work like our research on the gut/brain axis can be effectively translated into useful human practices.

INTRODUCTION

The FDA defines dietary supplements as “a product intended to add further nutritional value to (supplement) the diet” (U.S. Food and Drug Administration, 2017). The types of dietary supplements include vitamins, minerals, herbs, amino acids, and proteins. These supplements can come in many forms such as capsules, tablets, powders, and liquid.

According to a 2002 study done by Kaufman, he observed that 40% of people in the United States routinely take one or more types of vitamin or mineral supplements and 14% of the population takes herbal supplements. Figure 10 below summarizes the most commonly used dietary supplements in the United States (Institute of Medicine, 2005).

Figure 10: Top ten most popular dietary supplements in 2002 (taken from Institute of Medicine, 2005)

Vitamin or Mineral	Percent Use	Herbal Supplement	Percent Use
Multivitamin	26	Ginseng	3.3
Vitamin E	10	Gingko biloba	2.2
Vitamin C	9.1	Garlic	1.9
Calcium	8.7	Glucosamine	1.9
Magnesium	3.0	St. John's wort	1.3
Zinc	2.2	Echinacea	1.3
Folic acid	2.2	Lecithin	1.1
Vitamin B ₁₂	2.1	Chondroitin	1.0
Vitamin D	1.9	Creatine	0.9
Vitamin A	1.8	Saw palmetto	0.9
Any vitamin or mineral	40	Any herbal supplement	14

As shown in Figure 10, multivitamins were the most popular dietary supplements with 26% of the population taking it in 2002. Multivitamin continues to be one of the most popular dietary supplement as shown in Ipsos Public Affairs’ annual 2016 survey, it was shown that 75% of American dietary supplement users were taking multivitamins. In the same survey, the results showed that 42% of American adults consume dietary supplement to improve overall health. The survey also discussed an increase in the dietary supplement usage amongst the younger population with an increase of 5% of dietary supplement users aged 18 to 34 from the 2015 survey. CRN’s senior vice president of communication, Judy Blatman stated that there is an expected increase in dietary supplement usage amongst those aged 18 to 34 in the next 5 years (Nutraceuticals World, 2016).

In a different study done in 2001 by Blendon et al., it was found that almost half (48%) of all adult Americans take some form of nonprescription dietary supplements. Interestingly, the study also concluded that respondents who had a higher level of education reported greater use of dietary supplements than adults with less education. Moreover, it was found that regular users of dietary supplements were most likely to be white and non-Hispanic. Interestingly, Blendon et al., had also found that regular users of dietary supplements strongly believed that dietary supplements were useful, despite having insufficient scientific evidence, with 71% of users reporting that they would continue using the product, even if the Food and Drug Administration (FDA) specifically told them that dietary supplements are ineffective (Blendon et al., 2001).

Blendon et al., had also asked the participants about their perspective on governmental regulations of dietary supplements. The results showed that there was a large group of people who were confused about the government's role in regulating supplements, with more than half (53%) of the participants aware that the supplements are not regulated by the government, and 35% believing that dietary supplements are currently regulated, and 12% reporting that they do not know. Although, there was some confusion about the role of the government in regulating dietary supplements, the majority of the participants expressed support to increase government effort in regulating dietary supplements so that the supplements are not harmful and mislabeled, with 81% supporting the FDA having the authority to regulate dietary supplements only if the product passes a test given by the FDA, and 80% supporting the FDA removing dietary supplements from the market if a given supplement is proven to be unsafe. Although, there are a large number of people who support increased regulations, it was also noted that 71% of users would not want to give up their dietary supplements if they found that the dietary supplement that they were taking is found to not be safe. This discourse shows that the general American public is still confused about dietary supplement regulations (Blendon et al., 2001).

The Creation of the Dietary Supplement and Health Act

The Dietary Supplement and Health Education Act (DSHEA) was passed by Congress in 1994 due to public debates concerning the importance of dietary supplements in promoting health, the need for consumers to have access to current and accurate information about supplements, and controversy over the Food and Drug Administration's (FDA) regulatory approach to dietary supplements. Prior to the DSHEA, the FDA has tried to regulate dietary supplements as food additives or as drugs. Products that were regulated as food were ones where the primary use of the product was its taste, aroma, or nutritive value whereas a product was considered a drug if it made therapeutic claims. This caused a lack of access of dietary supplements for the population and Congress believed that "consumers should be empowered to make choices about preventive health care programs based on data from scientific studies of health benefits related to particular dietary supplements" (Barrett, 2003).

Figure 11: FDA Regulation of Food, Drugs, and Dietary Supplements (taken from Institute of Medicine, 2005)

Status	Dietary Supplements	Foods ^a	Food Additives	New Drugs ^b
Premarket approval required	No ^c	No ^d	Yes	Yes
Risk-benefit analysis conducted by FDA before marketing	No	No	Yes	
Postmarketing reporting or surveillance by industry required	No	No	Rarely	Yes
Burden of proof for demonstrating safety or lack thereof	FDA	FDA	Manufacturer	Manufacturer

- a Foods (including conventional foods and dietary supplements), unlike drugs, are considered safe (reasonable certainty of no harm), and thus risk-benefit analysis is not applicable.
- b This description applies to “new” drugs. Many over-the-counter drugs are regulated under FDA’s Over-The-Counter Drug Review procedures, which do not provide for postmarketing surveillance.
- c A 75-day premarketing notification, but not premarketing approval, is required for dietary supplements containing ingredients not marketed before 1994.
- d In 2001, FDA proposed a rule requiring marketers of food developed through biotechnology to notify the agency at least 120 days before commercial distribution and to provide information to demonstrate that the product is as safe as its conventional counterpart (FDA, 2001).

According to Section 3 of the DSHEA, Dietary Supplements are “any product (other than tobacco) intended to supplement the diet that bears or contains one or more of the following ingredients: a vitamin; a mineral; herb or other botanical; an amino acid; a dietary substance for use by man to supplement the total dietary intake; or a concentrate, metabolite, constituent, extract, or combination of any ingredient described” (Barret, 2003). DSHEA had immense support by the consumers when it was passed in 1994, as evidenced by approximately 2 million letters that was sent to the US congress in support of the act. The legislation passed in response to the massive support by the public and was passed to improve the health of Americans. The DSHEA allowed for consumers to be able to make their own choices on preventative health care, and in doing so, dietary supplements were regulated similar to foods, exempting manufacturers from conducting premarket safety and efficacy research. Figure 11 summarizes how the FDA regulates dietary supplements, food, and drugs after the DSHEA was passed (Institute of Medicine, 2005).

Other than rules on who is going to regulate dietary supplements, the DSHEA also involved labeling guidelines for dietary supplements, stating that any claims that the product can treat or cure a disease is prohibited. There are three types of claims that a dietary supplement is allowed to have on its label, health claims, structure-function claims, and nutrient content claims (Institute of Medicine, 2005). Figure 12 summarizes the three different claims.

Figure 12: Types of Dietary Supplement Label Claims (taken from Institute of Medicine, 2005)

Health Claim	Structure-Function Claim	Unallowable Disease Claim	Nutrient Content Claim or Percentage Claim
Regular exercise and a healthy diet with enough calcium helps teens and young adult white and Asian women maintain good bone health and may reduce their high risk of osteoporosis later in life.	Supports the immune system	Supports the body's ability to resist infection	Excellent source of choline; contains 55 mg of choline per serving, which is 10 percent of the daily value for choline (550 mg)
Healthful diets with adequate folate may reduce a woman's risk of having a child with a brain or a spinal cord defect.	Maintains healthy lung function	Protective against the development of cancer	More, added, extra vitamin C
Some scientific evidence suggests that consumption of antioxidant vitamins may reduce the risk of certain forms of cancer. However, FDA has determined that this evidence is limited and not conclusive.	Helps promote digestion	Promotes low blood pressure	

HEALTH CLAIMS

Health claims are established according to three methods: (1) FDA authorization after thorough review of a scientific literature, (2) an authoritative statement of scientific knowledge by the US government or National Academy of Sciences or (3) the results of the 1999 *Pearson v. Shalala* court decision which challenged four FDA denied health claims. The final decision of the *Pearson v. Shalala* court decision claimed that the FDA could not “reject health claims that the agency determines to be potentially misleading unless the agency also reasonably determines that no disclaimer would eliminate the potential deception (FDA, 1999)” (Institute of Health, 2005).

STRUCTURE-FUNCTION CLAIMS

Structure-function claims involve statements that include how a product may effect general well being due to consumption of a nutrient or dietary ingredient, or how the consumption of the supplement may maintain a particular structure or function of a healthy body. Examples could include claims such as “calcium builds strong bones”, and “ fiber maintain bowel regularity”. Since manufacturers are responsible for the accuracies of these claims, a product with a structure-function claim must include the disclaimer, “This statement has not been evaluated by the Food and Drug Administration. This product is not intended to diagnose, treat, cure, or prevent any disease.” The FDA is also notified of a structure-function claim within 30 days of a product containing such claims (Institute of Health, 2005)..

NUTRIENT CONTENT CLAIMS

Nutrient content claims include statements that describe the amount of nutrient or dietary substance in a product, using terms such as “good source”, or “high”. Nutrient content claims are usually used only for nutrients that contain an established daily value such as fat, cholesterol, and sodium. However, since many dietary ingredients lack an established recommended daily intake values, a sub category known as percentage claims exists where the claim describes the percentage of a product. Such examples could be claims such as “40 percent omega-3 fatty acids” or “twice the omega-3 fatty acids per capsule (80mg) as in 100mg of manhaden oil (40mg)” (Institute of Health, 2005).

Reasons for People Taking Dietary Supplements

According to an investigation done by Bailey et al., almost half (45.0%) of the adult American population in the years 2007 to 2010 decided to take dietary supplements because they wanted to improve overall health. The second most popular reason for American adults taking dietary supplements is to maintain health with 32.8% of the adults stating it as the reason for consuming dietary supplements (Bailey et al., 2013). Table 4 shows the results of the investigation done by Bailey et al.

Figure 13: Reasons for dietary supplement use amongst adults (≥ 20 years) by sex in the United States, 2007- 2010 (Taken from Bailey et al., 2013)

Reason	% (SE)		
	All Adults (n = 5514)	Men (n = 2450)	Women (n = 3064)
To improve overall health	45.0 (1.2)	46.4 (1.5)	43.9 (1.2)
To maintain health (stay healthy)	32.8 (1.1)	32.8 (1.4)	32.8 (1.4)
For bone health	25.2 (0.8)	11.3 (0.8)	35.8 (1.2) ^c
To supplement the diet	22.0 (1.1)	20.8 (1.2)	23.0 (1.4)
To prevent health problems	20.4 (0.8)	20.6 (1.0)	20.2 (1.0)
For heart health, lower cholesterol	15.1 (0.8)	17.6 (1.1)	13.2 (0.8) ^c
To boost immunity, prevent colds	14.5 (0.9)	15.8 (1.1)	13.4 (1.2)
For healthy joints, prevent arthritis	12.4 (0.6)	12.2 (0.9)	12.5 (0.8)
For enhanced energy	10.8 (0.5)	9.9 (0.8)	11.4 (0.6)
For skin health, dry skin	5.1 (0.5)	3.8 (0.7)	6.0 (0.7)
Other reason	4.5 (0.4)	3.4 (0.5)	5.4 (0.6)
For bowel or colon health	4.8 (0.4)	3.7 (0.4)	5.6 (0.6) ^c
For anemia, low iron	4.6 (0.3)	2.6 (0.4)	6.2 (0.5) ^c
For eye health	4.3 (0.3)	3.7 (0.4)	4.7 (0.4)
For mental health	3.7 (0.4)	3.9 (0.5)	3.5 (0.4)
For weight loss	2.6 (0.3)	2.0 (0.3)	3.1 (0.4)
For muscle-related issues	1.5 (0.2)	1.5 (0.3)	1.5 (0.2)
For healthy hair and nails	1.2 (0.2)	0.3 (0.1) ^d	1.8 (0.3) ^c
To improve sleep	1.1 (0.2)	0.9 (0.3) ^d	1.2 (0.2) ^c
For prostate health	NA	4.2 (0.4)	NA
For menopause	NA	NA	1.5 (0.3)
For pregnancy ^b	NA	NA	1.6 (0.3)

Abbreviations: NA, not applicable; SE, standard error.

^aData are presented as percentages (SE).

^bThese data are for nonpregnant females; pregnant women were excluded from this analysis.

^cIndicates significant difference between sexes; $P < .05$.

^dThe relative standard error is at least 30%, but not higher than 40% and may be statistically unreliable. The National Health and Nutrition Examination Survey guidelines recommend a relative standard error no higher than 30%.

From Figure 13, we can understand that most adults in the US are taking dietary supplements so that they can improve health, maintain health, or prevent a health problem. Although there are specific aspects of health such as bone health and eye health, that people are trying to improve or maintain, the general trend shows that most people take supplements in order to have an

overall healthier lifestyle. It is also interesting to note that in general, women were more worried about their bone health, whereas men were more likely to take supplements for heart health and to lower cholesterol (Bailey et al., 2013).

Although, there seems to be some differences in the reasons to take supplements depending on the gender, there was little to no difference in the reasons an adult would consume dietary supplements, according to age as shown in Figure 14.

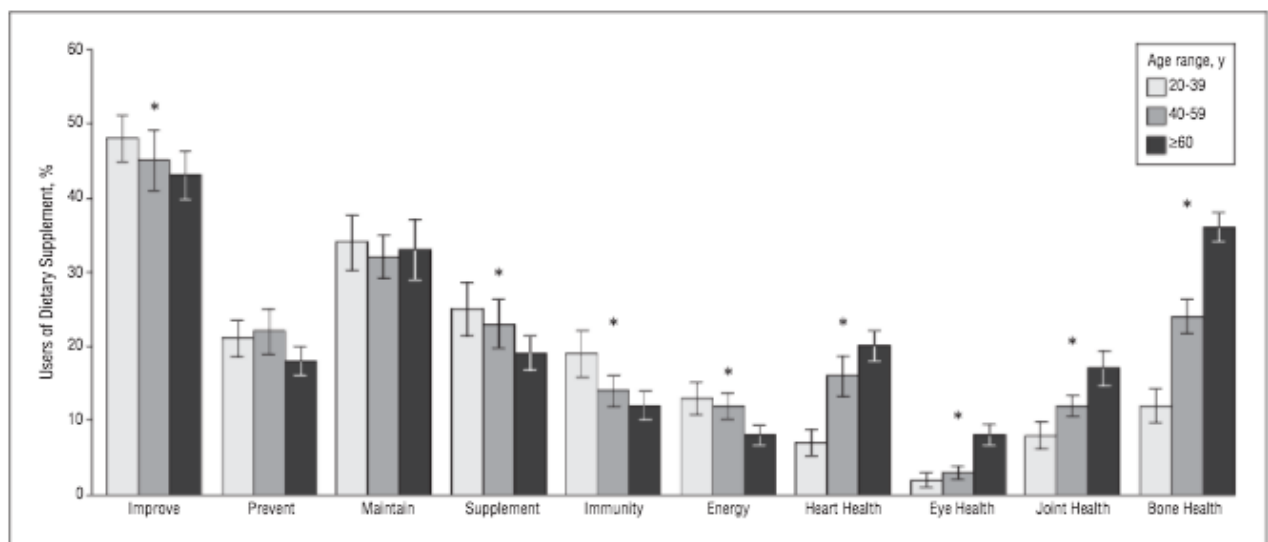


Figure 14: Reasons for taking dietary supplements, according to age (Taken from Bailey et al., 2013)

Looking at Figure 14, it can be understood that there are few difference in the reasons why adults of various age would take dietary supplements. However, an interesting point to note is for reasons relating to a specific health such as heart health, eye health, joint health, and bone health, we can see an increase in percentage of people indicating such concerns as the reason to consume dietary supplements. Although the number of people that took dietary supplements for reasons that involved overall health stayed almost the same, almost all of the reasons that involved a specific part of health, increased over time. This could possibly be due to older people having more specific problems that affect their health, and thus know what kind of supplements to consume as opposed to taking a supplement for overall health.

Dietary Supplements and Doctor-Patient Relationship

Because dietary supplements are mainly self-initiated and are regulated like a food item, patients often fail to inform their doctors about their dietary supplement use. This can cause issues that pertain to supplement safety, contraindications with prescribed medications, adverse effects, and efficacy. Without the knowledge of a patient taking dietary supplements, doctors may accidentally provide medications that may cause adverse effects. This is especially the case with herbal supplements where the knowledge of the effects of the supplement is little to none (NIH, 2015).

According to a 2012 study done by the National Center on Complementary and Alternative Medicine (NCCAM) and the AARP (formally known as the American Association of Retired Persons), it was shown that 42% of patients believed that they did not have to bring up supplement usage because they weren't asked, and 30% of patients didn't know that they should have raised supplement usage as an issue (Wallen and Brooks, 2012). Because of the general

understanding that supplements are similar to food items, and it is not known to be a form of medication, patients often do not mention using dietary supplements with their physician. With the increase in people taking more dietary supplements, it would be a good idea to train physicians to ask about dietary supplements and educate patients on talking about dietary supplements with their health care providers.

PILOT STUDY

Prior to the actual study, a pilot study was conducted with 50 articles from the years 2007 to 2016, using ten articles from five national newspapers. The purpose of the pilot study was to test data collection, interpretation, and validation procedures. Written public media articles referencing “dietary supplements” from 1/1/2000 to 12/31/2016 were accessed using the WPI electronic media database and independent subscription. Specifically, the articles from the *New York Times* were from WPI’s Gale Database and the *Chicago Tribune*, *Seattle Times*, *Orlando Sentinel*, and *Houston Chronicle* were from independent subscriptions. I followed a similar method outlined by Faber in his study on the emergence of nanoscience and nanotechnology (2006).

To best represent the entirety of the public media in the United States, I chose to use one major national source, the *New York Times*, and four regional sources, *Chicago Tribune*, *Seattle Times*, *Orlando Sentinel*, and *Houston Chronicle*.

The first search through the newspaper yielded a total of 3,557 articles. In order to narrow down the number of articles for the scope of the study, I decided to select the articles that contained the term “dietary supplement”, “supplement”, “diet supplement”, “vitamin” and words related to a specific supplement such as “calcium” or “iron”. Titles indicating that articles were briefing articles or had no mention of dietary supplements were omitted.

After filtering the results, I came up with a total of 467 articles. Figure 15 depicts the number of articles that were generated per year.

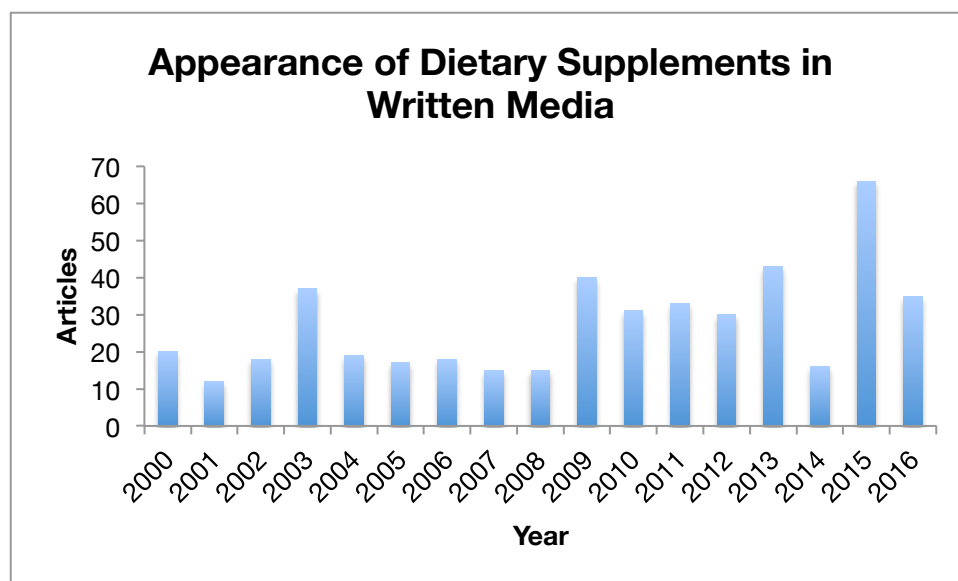


Figure 15: Appearance of Dietary Supplements in the Popular Articles from 2000-2016

Understanding the Value of Dietary Supplements

After reducing the newspaper articles to those specific to dietary supplements, articles were coded as positive, negative, or neutral. I wanted to determine whether the public perceptions of dietary supplements changed over time. Each article was examined and then categorized as positive, negative, or neutral. For this pilot study, ten articles from five newspapers were examined which made a total of 50 articles.

The Public Association with Dietary Supplements

Whilst reading the articles, major topics emerged as primary topic categories. Twelve different categories that represent the public opinions of dietary supplements (*representation*) from 50 newspaper articles were recorded. After I created the 12 categories, I revisited the 50 newspaper articles and re-categorized each of the articles to ensure validation. In addition to the 12 different categories that represent the public opinions of dietary supplements, I categorized each of the articles according to which types of dietary supplements were being referenced.

FINDINGS AND DISCUSSION

The Value of Dietary Supplements

The results that were generated from this study showed the representations of the articles as positive, negative or neutral. Figure 16 displays the percentage of articles from the year 2007 to 2016 coded as positive, negative, or neutral in content related to dietary supplements.

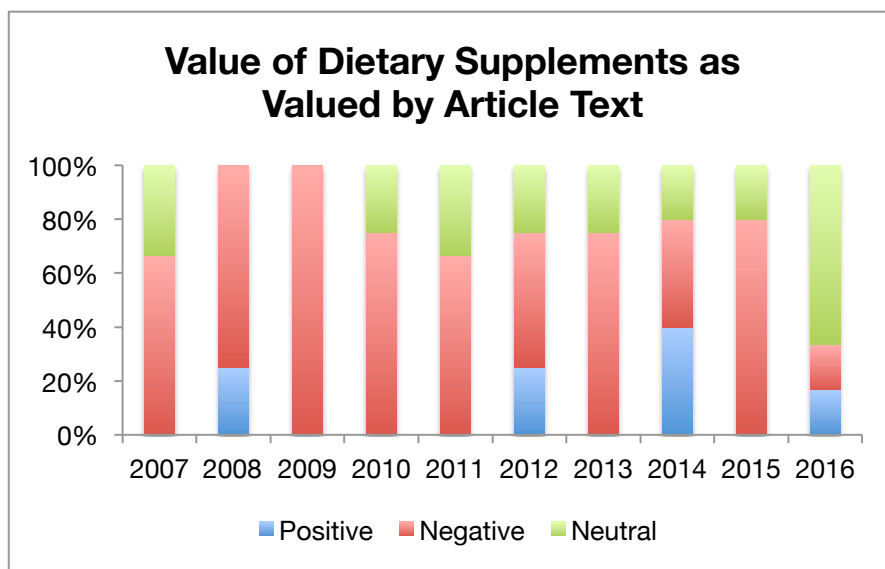


Figure 16: Depiction of Dietary Supplements Value – Positive, Negative, and Neutral

Pilot study data shows that popular media has reported dietary supplements as primarily negative. With the exception of 2016 where most articles had a neutral perspective, most articles had a negative opinion of dietary supplements. Reasons for this negative portrayal can be further investigated by looking at the 12 major representations of dietary supplements in the next section.

Representations of Dietary Supplements

Figure 17 displays the percentage occurrence of the 12 major topics in the 50 articles that were read for this proposal. Nearly half (45%) of the 50 newspaper articles concerned FDA regulations. The second most occurring topic was the idea of lack of evidence for claims about dietary supplements. These two representations explain the predominant negative coverage in written media. Topics included lax FDA regulations, a lack of evidence in taking dietary supplements, and reports of side effects, although side effects could mean positive or negative side effects. However, most people perceive side effects as something negative.

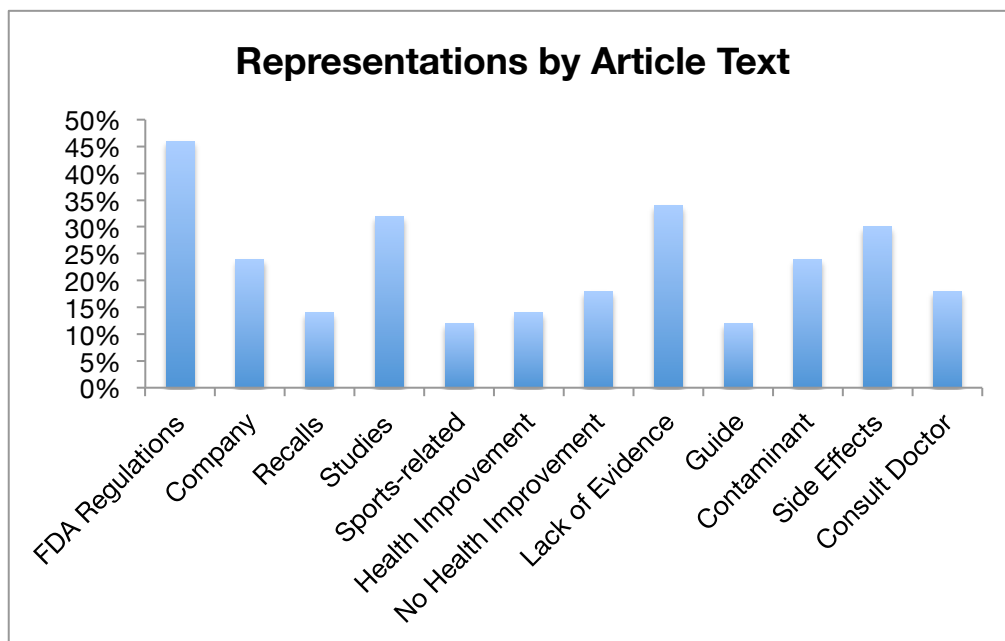


Figure 17: Percent occurrence of the representations by article text

“Recalls” and “Contaminant”: The two representation seems to be interrelated, however Figure 3, shows that the occurrence of articles relating to contamination of dietary supplements was higher than articles relating to recalls. Most companies would want to recall their products if they find that there are some contaminants. However as Figure 17 shows, there does not seem to be a statistical relationship between these two topics.

“Health Improvement”, “No Health Improvement”, and “Lack of Evidence”: Approximately 35% of articles presenting dietary supplement claims lacked adequate scientific evidence, which explains why there was a lower occurrence (14%), (18%) of the other two representations. The lack of evidence could be the reason to the majority of the articles being valued negatively because a lack of evidence in improving health means that there could be no point in taking the dietary supplements.

“Lack of Evidence” and “Side Effects”: Figure 17 shows that the number of articles that had “Lack of Evidence” and “Side Effects” were similar (34%), (30%). The two topics go hand in hand since there could be a lack of evidence in the side effects of the dietary supplements. Due to the lack of evidence in the side effects of dietary supplements, most newspaper articles were valued as negative because people may be more hesitant to take a supplement that may harm their health.

The 50 newspaper articles were then categorized according to the types of dietary supplements mentioned. Figure 18 shows the seven categories of dietary supplements that were identified in the articles. Articles that did not refer to a specific type of dietary supplements were categorized under general dietary supplements.

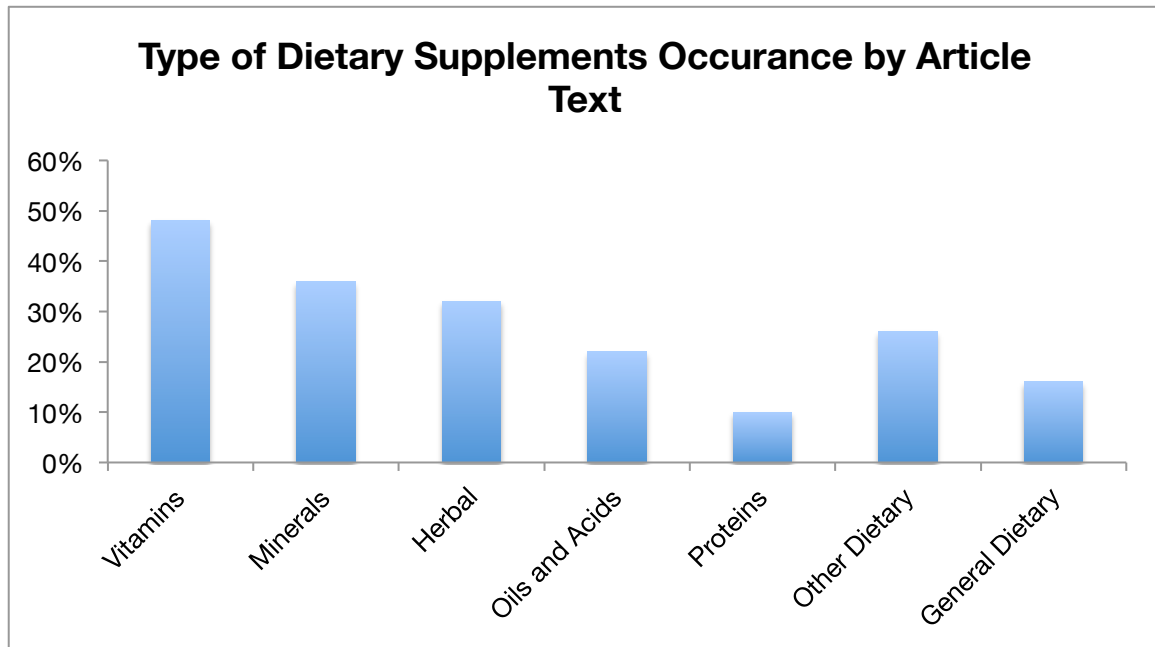


Figure 18: Percent occurrence of types of dietary supplements by article text

Figure 18 shows the “General Dietary Supplements” category has a relatively small number of articles (16%), which could mean that not all types of dietary supplements were valued as negative. To further investigate the values of each of the dietary supplements, the articles were re-categorized according to its values. Figure 19 shows the percentage articles according to the type of dietary supplements mentioned and their values.

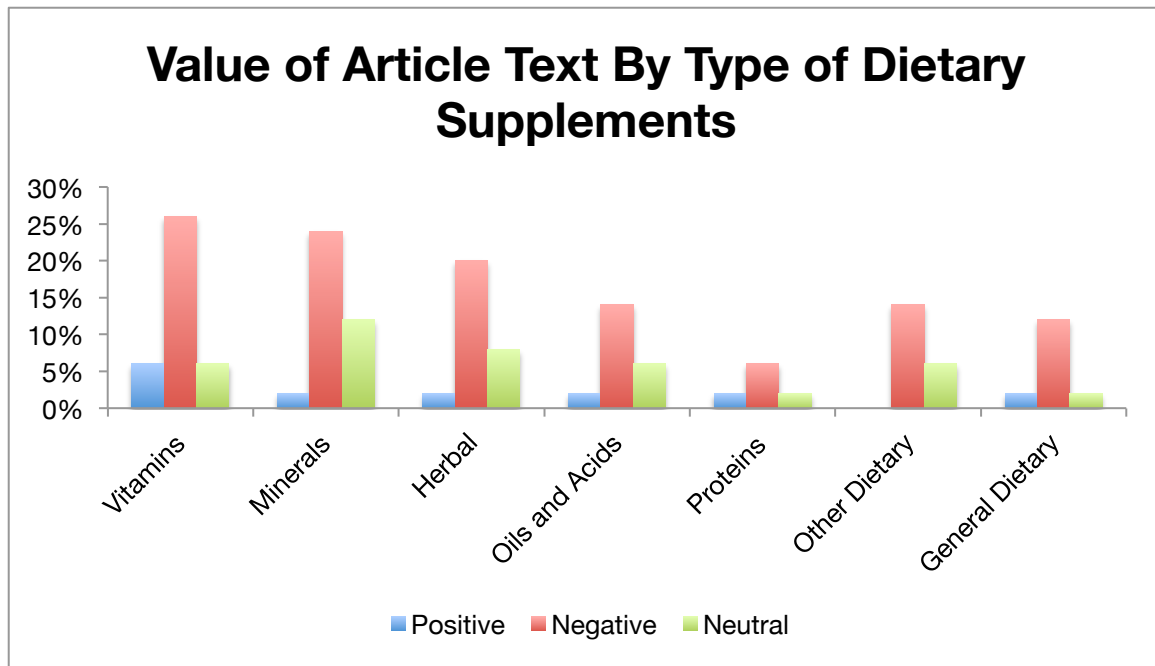


Figure 19: Depiction of Dietary Supplement Values according to Type of Dietary Supplement

Figure 19 shows that all of the dietary supplements types are highly valued as negative. This could be because most articles focused on the lack of evidence that the dietary supplements have on improving health. Another possibility to the negative association to dietary supplements could be because of weak FDA regulations. According to the FDA website, the firms that produce the dietary supplements are responsible for evaluating the safety and labeling of their products before the product is put in the market (U.S. Food and Drug Administration, 2017). Unlike prescription drugs, which have to go through extensive reviews, dietary supplements have easier regulations as the FDA views dietary supplements as food as opposed to drugs.

THE STUDY: DATA COLLECTION AND ANALYSIS

Although in the pilot study it was indicated that all 467 articles would be used from the years 2000 to 2016, the actual study involved using articles from the years 2007 to 2016 in order to reduce the number of articles. The final study involved 252 articles across the years 2007 to 2010. Figure 20 depicts the number of articles that were generated per year.

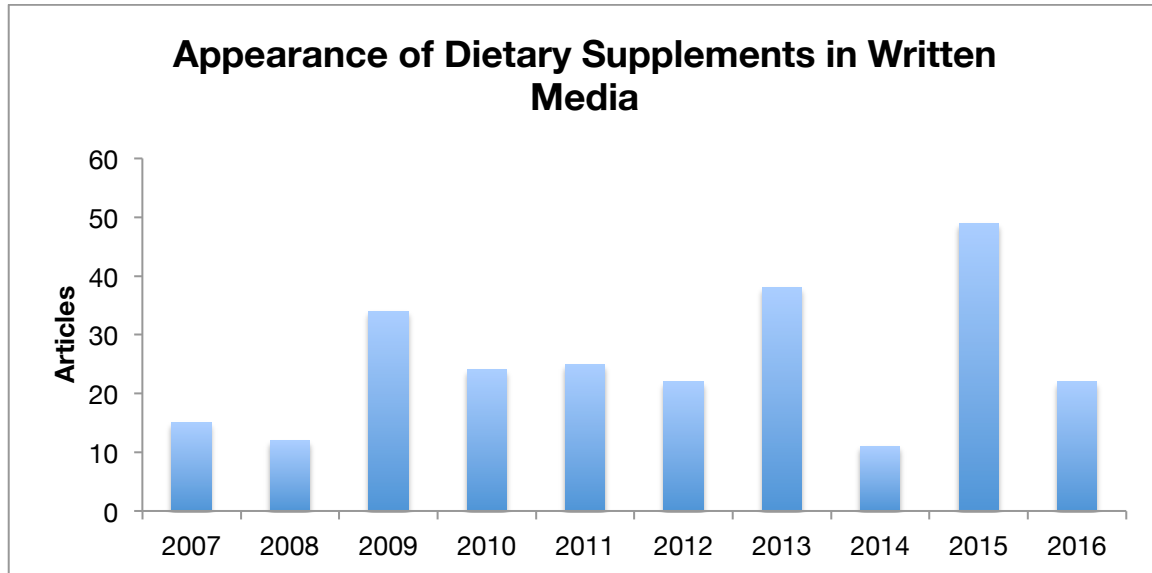


Figure 20: Appearance of Dietary Supplements in the Popular Articles from 2007-2016

Understanding the Value of Dietary Supplements

After reducing the newspaper articles to those specific to dietary supplements, articles were coded as positive, negative, or neutral. I wanted to determine whether the public perceptions of dietary supplements changed over time. After the pilot study, I realized there was a need for a fourth category, “both” where an article had both positive and negative perceptions of dietary supplements, thus an additional category was added, and each article was examined and then categorized as positive, negative, neutral, or both.

The Public Association with Dietary Supplements

Whilst reading the articles, major topics emerged as primary topic categories. 18 different categories that represent the public opinions of dietary supplements (*representation*) from 252 newspaper articles were recorded. After I created the 18 categories, I revisited the 252 newspaper articles and re-categorized each of the articles to ensure validation. Although in the pilot study I further investigated the types of dietary supplements being referenced and categorized articles according to its values, I decided not to do so in this study due to almost all supplement type having mostly negative values thus showing no trend.

FINDINGS AND DISCUSSION

The Value of Dietary Supplements

The results that were generated from this study showed the representations of the articles as positive, negative, neutral, or both. Figure 21 displays the percentage of articles from the year 2007 to 2016 coded as positive, negative, or neutral in content related to dietary supplements.

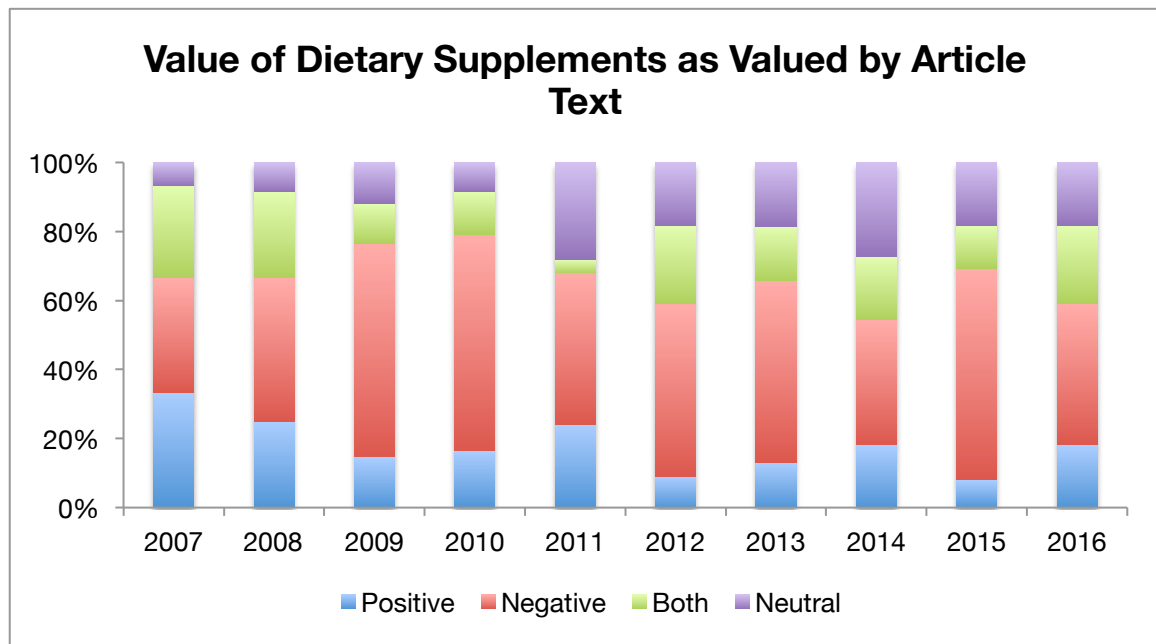


Figure 21: Depiction of Dietary Supplements Value – Positive, Negative, and Neutral

To simplify the above figure, I re-generated a graph that did not include the articles that were associated with both positive and negative ideas of dietary supplement usage (“both”) or none at all (“neutral”). Figure 22 shows articles that were more polarized as either overwhelmingly positive or negative:

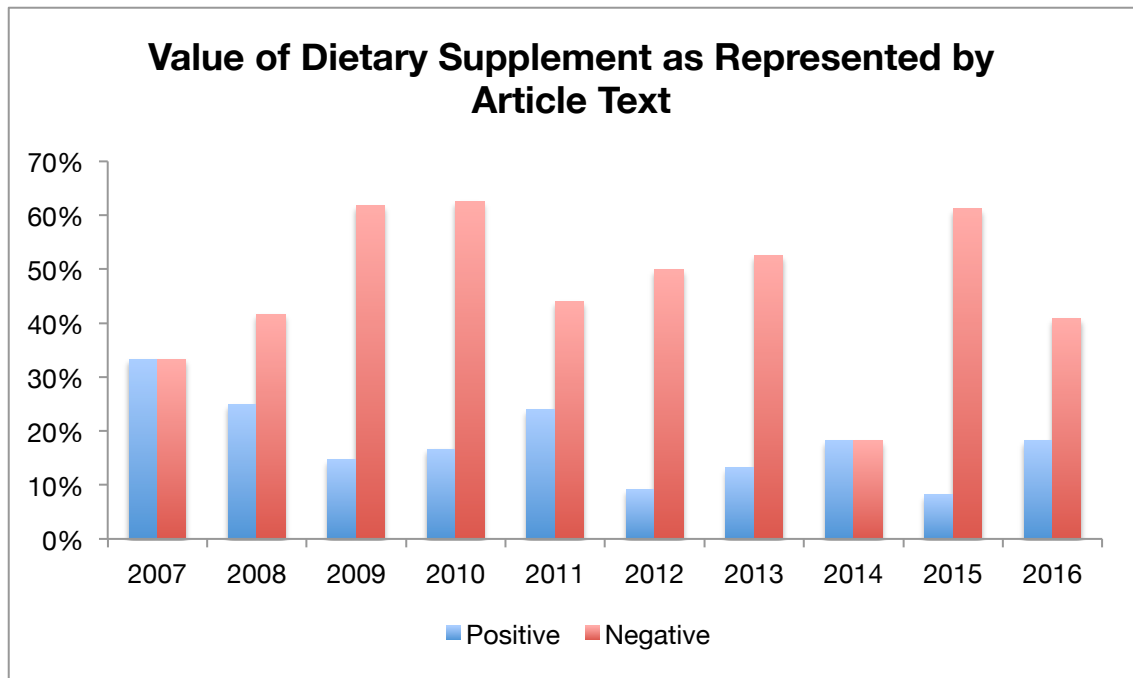


Figure 22: Simplified Depiction of Polarized Dietary Supplements Articles – Positive or Negative

The general trend shows that popular media has reported dietary supplements as something primarily negative. With the exception of 2014 and 2007, where there were equal numbers of articles, the percent negative article per year remained stable at 40% to 60%. Reasons for this negative portrayal can be further investigated by looking at the 18 major representations of dietary supplements in the next section.

Representations of Dietary Supplements

The list of representation of dietary supplement stands for the major topics that dietary supplements are associated with, and these categories were identified directly from the text of the data set. Figure 23 displays the percentage occurrence of the 18 major topics in the 252 articles that were read for this study.

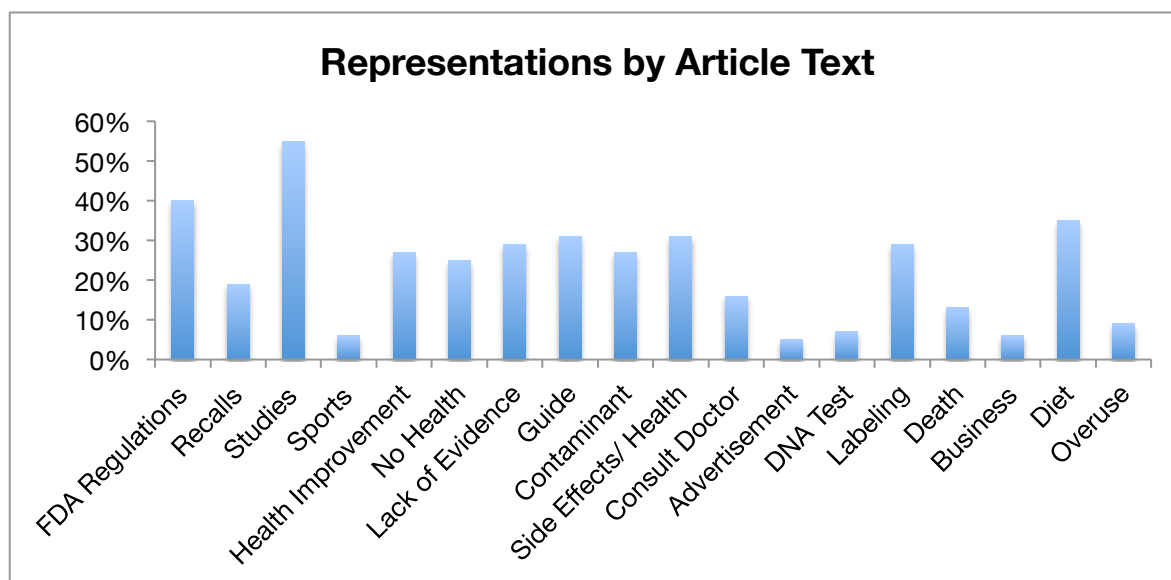


Figure 23: Percent occurrence of the representations by article text

Assuming equal occurrence, each of the 18 representations would, in theory, comprise roughly 6% of each year’s total articles. However, the representations produced great variability in the rate of occurrences, having two or more representations dominating every year, regardless of the quantity of articles in each year, at 10% or higher of the total representations in that year. These major representations contribute to a common public understanding of dietary supplements in each of the last ten years. Figure 24 depicts which of the representations dominated through the written media of the data set in each year, providing insight into the major “buzzword(s)” of dietary supplements over time:

Figure 24: Table of Top Major Dietary Supplements Association by Year from 2007 to 2016

Year	Major Representations with at least 10%
2007	Studies, and FDA Regulations
2008	Studies, Diet, Guide, Side Effects, Health Improvement, and No Health Improvement
2009	Studies, FDA Regulations, and Lack of Evidence
2010	Studies, Diet, and No Health Improvement
2011	Studies, FDA Regulations, and Diet
2012	Studies, FDA Regulation, Diet, Guide, Lack of Evidence, and Contamination
2013	Studies, FDA Regulation, and Diet
2014	Studies, FDA Regulation, Health Improvements, and Contamination

2015	Studies, and Labeling
2016	Studies, FDA Regulation, Diet, Guide, and Side Effects

The purpose of this study was to gain a thorough view of the understanding of dietary supplement use in the public media. Therefore it was essential to identify not only the highest occurring representations, but also the rate of occurrence of each representation. By doing this, I was able to interpret the rate of occurrence of the understanding and perceptions of dietary supplement use from how often associated and least often associated, further altered by time.

The 18 representations previously identified occurred a total of 1026 times. To identify which of the categories had high, average, and low occurrences, the 75th percentile was found to be 77 articles, 50th percentile to be 65 articles, and the 25th percentile to be 22 articles. Any representations that had the total number of articles more than 77 was categorized as high occurring, between 22 to 77 articles were categorized as average occurring, and less than 22 to be low occurring. Figure 25 details those 5 representations that had higher than average occurrences. Figure 27 details the 8 representations that had the average amount of occurrences, and finally, Figure 29 details the 5 representations that had less than average occurrences. Figures 26, 28, and 30 show the trends for each representation in each year, graphed to indicate any notable trends.

Figure 25: Table of Topic Categories, High Count (>77)

Topic	Total
Studies	138
FDA Regulation	100
Diet	88
Guide	77
Side Effects/ Health Risks	77

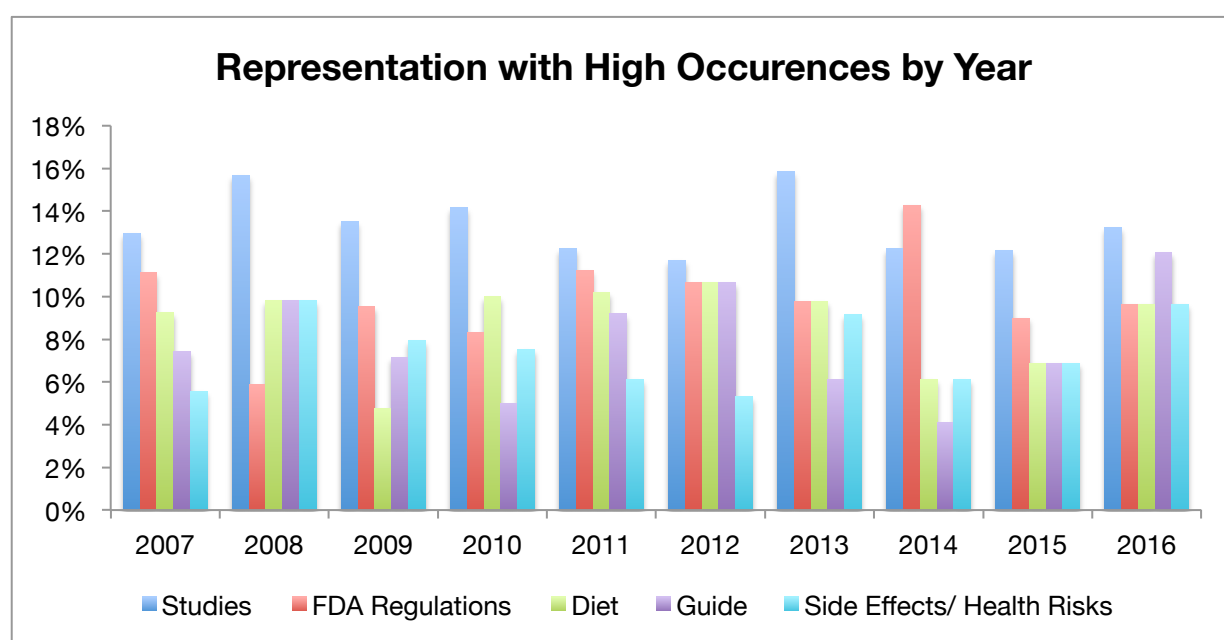


Figure 26: Representations with High Occurrences Graphed by Year

Temporal Findings: As expected, each of the high occurring representations appeared in each of the ten years from 2007- 2016. There are two major areas of representations that are associated with dietary supplements, safety and health concerns. All high occurring major topics were related to either the safety of dietary supplement use as shown by the representation FDA regulations (in red), and side effects/ health risks (in light blue), or health concerns, as shown by studies (in blue), diet (in green), and guide (in purple). This suggests the public’s concern on their health as well as the safety of dietary supplement use. All the representations have similar trends throughout the years, showing almost similar amounts of occurrences throughout the years.

Figure 27: Table of Topic Categories, Average Count (22-77)

Topic	Total
Lack of Evidence	74
Labeling	72
Health Improvement	68
Contamination	67
No Health Improvement	63
Recalls	47
Consult Doctor	40
Death	32

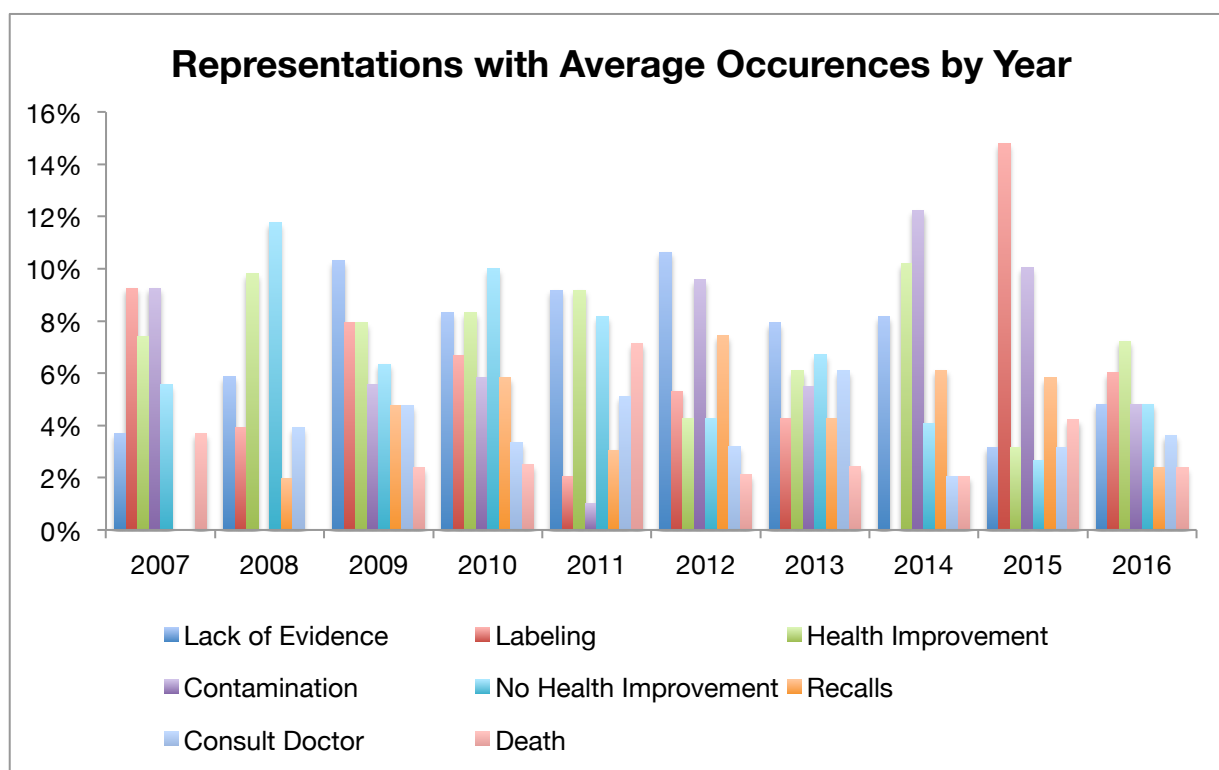


Figure 28: Representations with Average Occurrences Graphed by Year

Temporal Findings: In 2009, 2010, 2011, 2012, 2013, 2015 and 2016, each contained at least one article in each of the representations. However, in 2007, there were no articles on recalls, and consulting doctors, in 2008, there were no articles on contamination, and death, and in 2014,

there were no articles on labeling. There were several notable trends, which are briefly described below:

Labeling: This representation (indicated by red in the graph above), generally show a consistent trend, occurring less than 10% of the data set throughout the years. However, in 2014 there were no articles on labeling, possibly due to the small number of articles regarding dietary supplements in that year. Another surprising trend is the large increase in articles relating to labeling in 2015, with 15% of the year's article relating to labeling.

Contamination: This representation (indicated by purple in the graph above), show a general decrease in occurrence from 2007 to 2011, then a sudden increase in 2012 to 2015. Additionally in 2016, the number of articles decreases again to 5%, almost half the number of articles from the previous year, indicating a possible decrease in contaminated dietary supplements.

Recalls: This representation (indicated by orange in the graph above), show an increase in occurrence from 2007 to 2010, then a sudden decrease to 3% in 2011. The occurrence of recalls once again increases from 2012 to 2015, then decreases to 4% in 2016. Comparing to the occurrence of contamination, it had similar trends, possibly indicating the improvements in dietary supplement regulations.

Death: This representation (indicated by light red in the graph above), show a gradual increases in the occurrence from 2008 to 2011 and then a gradual decrease in the occurrence from 2012 to 2016. It is interesting to note that despite in 2011, the occurrence of death was one of the highest in the ten years; the occurrence of contamination was small, possibly indicating that contamination may not have been the factor causing death.

Dietary Supplements: Low-Occurring Representations

Figure 29: Table of Topic Categories, Low Count (<22)

Topic	Total
Overuse	22
DNA Test	17
Sports	16
Business	15
Advertisement	13

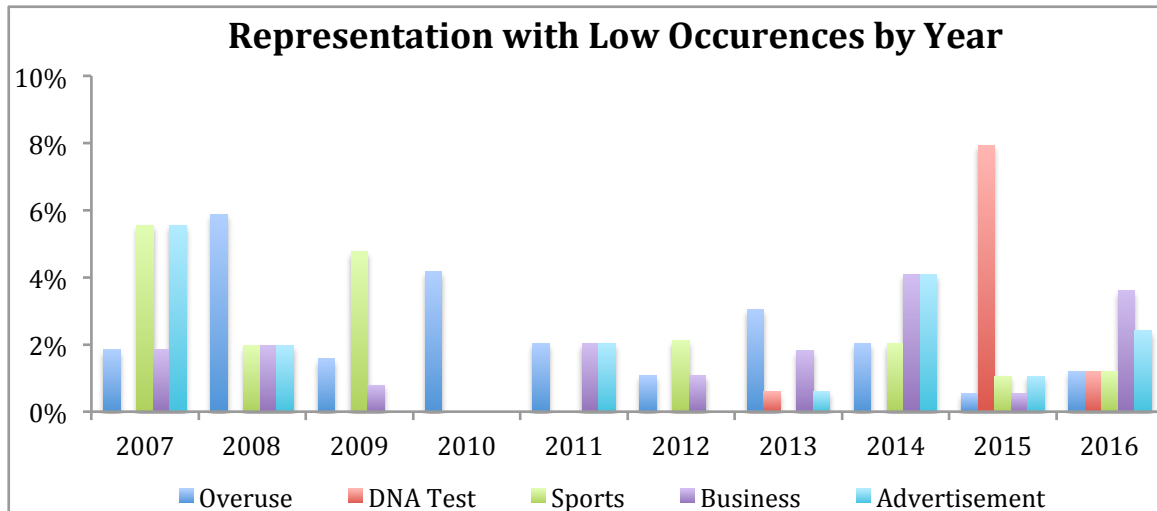


Figure 30: Representations with Low Occurrences Graphed by Year

Temporal Findings: 2015 is the only year that each of the low-occurring representations appeared in at least one article. The only representation that persisted throughout the year is overuse. Several notable trends are briefly described below:

DNA Test: This representation (as indicated by red in the graph above), only show up three times throughout the ten-year span. Although, this representation is small, it is interesting to note that in 2015, there was a sharp increase in the occurrence of DNA test. Not only is this increase in occurrence due to the large number of articles in 2015, DNA test seemed to be one of the major topics in 2015.

Sports: This representation (as indicated by light green in the graph above) had a relatively higher occurrence in 2007 then slowly decreased over time. This suggests a shift in the public’s perception of dietary supplement, from being a product that people thought should be used for sports to something that is more for a health product.

CONCLUSION

News reports have emphasized public safety, regulations, and the efficacy of dietary supplements as reported in the scientific literature. This suggests that patients will receive a considerable amount of their medical education regarding dietary supplements from the news media.

Because dietary supplements can easily be obtained, most patients will self-initiate the use of dietary supplement with little knowledge about potential risks or benefits.

The study shows the need for both continued research into:

- (1) The physical effects and mechanisms of action of dietary supplements and
- (2) Better methods for providing patients and consumers with accurate and useful information about dietary supplements.

CHAPTER THREE

A Reflection on the Socio-Technical Paradigm

A PERSONAL REFLECTION ON EXPLORING THE BRIDGE BETWEEN THE HUMANITIES AND THE SCIENCES

Paul Rabinow observed multiple times through his work as an anthropologist that there are inefficiencies that arise when the humanities and the sciences try to work together. Through his research he came to a conclusion that the humanists are only working with the scientists before and after the act: (1) putting regulations in place to prevent scientists from overstepping the bounds of “proper science” or (2) stopping a scientific act after scientists already overstepped the bounds. In other words, the humanists are either setting regulations in place that may be invalid, outdated, or extreme, or they are accepting scientific advances with much hesitations or outright refuting it. Thus far there has been little to no attempt at creating a bridge between the two disciplines to establish common goals and laws, which can then be followed by both. Rabinow believes that bridging the two disciplines has been unsuccessful due to both disciplines not having an understanding of each other, and in order for the two disciplines to work together, the two need to understand each other first (Rabinow, 1999).

There were multiple times at WPI, where I believe there was an attempt at bridging the two disciplines together, one obvious example being the Interactive Qualifying Projects (IQP). Looking at the learning outcomes of the IQP, the very first outcome relates to bridging the two disciplines together, “Demonstrate an understanding of the project’s technical, social and humanistic context”. Although for many students, this learning outcome may have been achieved due to having a project that has good balance of both technical and humanistic aspect, I believe my project failed to incorporate the two aspects together, not because of the project itself but because of myself, my teammates, as well as our advisors’ failing to understand how the two disciplines can work together.

My project’s main goal was to increase engagement in a community garden in Thessaloniki, Greece. Throughout our project, we were going to learn about the community and eventually come up with a solution that may help with increasing the engagement or help the already existing community have a better space for them to interact. Our team understood that in order for us to come up with a solution, we would need to recognize the needs of the people that are involved in the community garden. This involved spending time with them and getting to know the community. After spending some time with the community, we realized that one aspect of the garden that the gardeners wanted to see improvements was the compost facility that they had. Since my other teammates were all mechanical engineers, they took the initiative of coming up with a solution to the composting problem. However, when we brought it up to our advisors, it was brushed off as something that was irrelevant and that we should focus our attention on continuing to learn about the community. To my teammates’ dismay, they were disappointed and found it pointless to continue the project, failing to understand how the project was going to help with their engineering career.

Thinking back, it made me realize that this experience was a perfect example of how the two disciplines fail to understand each other. To my teammates, the humanistic side of the IQP was pointless because they believed that their careers would involve coming up with solutions and that they could do so without the need to interact with the people themselves. To them, understanding the users was a job for the humanists. Similarly, our advisors firmly believed that since the IQP is a social science/ humanities project, it should be kept solely humanistic, although the learning outcome states that the IQP is for solving interdisciplinary problems. However, if our advisors had allowed us to create a design for the compost, my teammates may or may not have understood the importance of getting to know the community because they would focus solely on getting a design as a final product. In order for both my team and the

advisors to have come to an understanding of the two disciplines was to have us work side by side and set a common goal that would result in satisfying both disciplines, which would result in a project that would be able to bring the humanities and the sciences together.

Maybe because my IQP experience was one where I wasn't able to fully explore the bridge between the two disciplines, I decided to pursue a second major in Professional Writing (PW). Before starting on my combined MQP, I didn't know what sort of project I would be working on and the only project I had in mind was one where I would explore in-depth a disease relating to my biochemistry (BC) research. However, after my first meeting with my PW advisor and learning about his past work on popularized nanotechnology, as well as his past MQP student who worked on synthetic biology, I was fascinated by the idea of conducting similar research on dietary supplements.

When I first started the PW portion of the MQP, I had no idea on what people thought about dietary supplements or how it was represented in the newspapers. I had read a few articles on dietary supplements prior to the research and always thought that they were bad for your health and that it was something that may be harming one's body. However I had also noticed that many of my friends were taking supplements despite the articles saying that it may be harmful. I was confused by this discourse so I was curious to understand if what I had read about supplements being harmful was true and why people still continue to take dietary supplements despite the negative connotations associated with it. Whilst gathering some articles for the research, I realized that there was more to it than whether dietary supplements are good or bad. The topics that emerged included regulations, DNA testing, as well as guides for choosing supplements. Just from gathering newspaper articles from the past 10 years, I was able to observe that there were varying opinions on dietary supplements and it wasn't as simple as whether something was good or bad, and in most cases, it was unclear as to whether dietary supplements were helping or not helping an individual.

The complex set of data that I came up with made me recognize that it is difficult for science to stand by itself and that there will be no meaning to research without the humanities. People are interested in the kind of research scientists are performing and it is up to the humanists to be able to translate these ideas across to the public. Moreover, scientists are able to come up with their research through humanists because they are the people that will be funding their research and will have to eventually accept their work. Thus the two disciplines need each other in order for each of their work to have meaning.

A few weeks ago, I attended my BC advisor's presentation where he talked about the research that goes on in his lab. Before he discussed about the details on the mechanistic of the project, he wanted to pull our attention to the bigger picture of the research. He mentions how he wanted to take a "holistic" approach to his research and that he is interested in the project because of the increasing number of people that are having migraine headaches. He believes that there is an increased attention to understanding the microbial gut brain interactions both in the sciences and in the public media such as newspapers. Because of the increased attention in the area, he wanted to pursue a project that would be of interest to both the scientists and the general public so that he would be able to play a role in coming up with something that would be meaningful to everyone. When I heard that my advisor had wanted to come up with a project that was meaningful to everyone, I realized that my PW project was something that would be of interest to people in the lab.

I had been afraid to talk about my PW project with some of my lab members because I had thought that they wouldn't be interested in a humanities project, although it is related to the

work I do in lab. From my time at WPI, I realized that most WPI students disregard the humanities projects, due to not understanding their relevance to their technical courses, I was afraid that if I had mentioned my project, it would be disregarded as something unimportant. However, I firmly believed that the PW project provided more meaning to the experiments that I had been performing in lab and it allowed me to understand that there are people other than scientists that would find use in the research that I am conducting. Much like how my BC advisor had talked about taking a holistic approach to science, I believe that the PW project allowed me to understand the bigger picture of my BC research and how the results that I find will be presented to the public.

One way that I was able to understand an attempt that people have made to close the gap between the two disciplines, is through an architect's building design. During winter break, I visited the Hospital of the Holy Cross and Saint Paul in Barcelona, Spain. This building is a UNESCO world heritage site and was designed by one of Spain's most important architect, Lluís Domènech i Montaner.



Figure 31: Hospital of the Holy Cross and Saint Paul, Barcelona Spain (taken from <http://www.barcelonaclinicaltrials.org/en/sant-pau-biomedical-research-institute>)

When I first stood in front of the hospital building, I thought that this was going to be another buildings where the architect just wanted it to look beautiful and possibly having some religious symbolism of life. However, after walking through the self-guided tour, I realized that the architect was putting a lot of effort into the design of the hospital so that the patient is able to recover fast and with comfort. From creating the building so that it faces the sun to the small sunroom that each ward had, it allowed for patients to experience a pleasant stay so that they will be able to have a faster recovery.

Before Montaner created this hospital, he went around the hospitals in Barcelona and realized that most of the hospital looked like a prison. He believed that if people who aren't sick felt sick after spending time at the hospital, patients would feel worse after being in such place. Because of the bad quality of hospitals in Barcelona, he wanted to create a hospital that would be functional yet beautiful, allowing the patients to recover in a place where they can admire the beauty of the building and recover through the designs. One of the most striking aspects of the building design that I remember was how he had designed the walkway to the hospital buildings on a slight hill. Not only was this done so that the rain water would be guided down the drain, but he had done this so that the patients will be able to have a little bit of exercise on days that

the patients would want to spend some time outside. I was fascinated that Montaner had kept the patient's well being in mind whilst creating the hospital and was amazed at how he was able to put the two discipline together through his art work.

Just like Montaner was able to close the gap between the sciences and the humanities, my goal for the MQP was to be able to understand the two disciplines and how one discipline may be able to help the other to come up with a common goal. So far, I have found that there is no straightforward answer that addresses the disconnect between the disciplines. Although people like my BC advisors are more open to understanding the humanists' perspectives of research, there is still a lack of understanding between the two disciplines as shown by my IQP experience. My IQP advisors were trying to push the humanities aspect of the project, disregarding any of my teammates' technical input, whereas, my teammates could not understand why there was a need for a humanistic project. Because we have been taught that the sciences and the humanities are two separate disciplines and that it has been ingrained in us that there are very little overlap between the two disciplines, it is difficult to close the gap between the humanities and the sciences.

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APPENDIX

Supplemental to Chapter 2

Figure 1: Representation Tracking

Index	Value_class	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
2016N Y-1	Both	1											1		1			1	
2016N Y-2	Positive			1		1			1										1
2016N Y-3	Positive			1		1			1										1
2016CT -1	Negative	1									1							1	
2016CT -2	Negative	1								1					1				
2016CT -3	Neutral			1					1										1
2016CT -4	Negative	1	1							1							1		
2016CT -5	Both			1				1	1		1								1
2016CT -6	Negative	1			1										1				
2016CT -7	Neutral			1		1		1	1			1							
2016O S-1	Negative	1		1			1				1	1							1
2016H C-1	Negative			1				1			1								
2016H C-2	Both			1			1				1								
2016H C-3	Negative								1		1	1							1
2016H C-4	Negative	1								1	1				1				
2016H C-5	Neutral						1								1			1	
2016H C-6	Positive					1			1				1						
2016H C-7	Positive			1		1			1										1
2016H C-8	Both													1					

2016H C-9	Negative	1	1						1	1					1			
2016H C-10	Both			1		1	1		1								1	
2016H C-11	Neutral			1				1	1								1	
2015N Y-1	Negative												1	1				
2015N Y-2	Negative													1				
2015N Y-3	Negative													1				
2015N Y-4	Negative													1			1	
2015N Y-5	Neutral													1			1	
2015N Y-6	Both													1	1			
2015N Y-7	Negative													1	1			
2015N Y-8	Negative														1			
2015N Y-9	Negative														1			
2015N Y-10	Negative														1		1	
2015N Y-11	Negative														1			
2015N Y-12	Negative														1	1		
2015CT -1	Negative		1	1					1					1	1			
2015CT -2	Neutral							1		1	1						1	
2015CT -3	Neutral							1	1	1	1				1			
2015CT -4	Negative				1			1	1								1	1
2015CT -5	Neutral	1		1				1										
2015CT -7	Negative	1	1	1			1		1	1				1	1			
2015ST -1	Negative	1		1						1	1			1	1			
2015ST -2	Negative	1						1			1			1				

2015ST -3	Negative	1		1					1	1			1	1			
2015O S-1	Positive			1		1			1						1		
2015O S-2	Negative	1	1						1					1			
2015O S-3	Negative	1	1	1					1				1	1			
2015O S-4	Negative	1	1						1				1	1			
2015O S-5	Positive					1			1								1
2015O S-6	Positive					1			1								1
2015O S-7	Negative			1	1		1				1						
2015O S-8	Negative	1	1	1					1	1				1	1		
2015O S-9	Neutral			1					1								1
2015O S-10	Positive			1		1			1								1
2015H C- 1	Neutral					1	1	1				1			1		
2015H C- 2	Negative	1	1	1					1				1	1			
2015H C- 3	Negative	1	1	1					1				1	1			
2015H C- 4	Both	1	1	1					1				1	1	1		
2015H C- 5	Neutral											1					
2015H C- 6	Negative	1		1			1		1								
2015H C- 7	Neutral	1		1					1				1	1			
2015H C- 8	Negative								1	1					1		
2015H C- 9	Negative			1				1	1	1							
2015H C- 10	Both			1		1			1								
2015H C- 11	Both			1		1		1	1								
2015H C- 12	Negative								1				1	1			1

2015H C- 13	Both	1	1						1					1	1		
2015H C- 14	Both	1		1					1	1	1				1		1
2015H C- 15	Negative			1						1							
2015H C- 16	Negative			1			1										1
2015H C- 17	Negative	1	1				1		1	1				1			1
2014N Y-1	Negative	1		1					1	1							1
2014N Y-2	Both	1	1			1			1								
2014N Y-3	Positive	1			1	1			1				1				
2014CT -1	Negative	1	1				1		1	1							
2014CT -2	Negative	1	1	1					1								
2014ST -1	Negative	1							1	1					1		
2014O S-1	Positive	1		1		1		1								1	
2014H C-1	Both			1		1	1									1	
2014H C-2	Neutral			1		1		1				1	1				1
2014H C-3	Neutral			1		1	1										1
2014H C-4	Neutral					1		1									1
2013N Y-1	Neutral			1		1	1	1									
2013N Y-2	Negative	1								1					1		
2013N Y-3	Negative	1	1						1	1					1		
2013N Y-4	Negative	1	1							1							
2013N Y-5	Both	1	1	1					1	1	1			1			
2013N Y-6	Both			1		1	1	1								1	1
2013N Y-7	Negative	1		1					1	1						1	

2013CT -1	Positive					1			1				1			1	1			
2013CT -2	Negative	1	1						1		1			1						
2013CT -3	Both	1		1				1												
2013CT -4	Negative	1	1						1	1	1									
2013CT -5	Both	1		1		1	1	1				1					1	1		
2013CT -6	Positive			1				1	1			1						1		
2013ST -1	Neutral			1			1	1										1		
2013ST -2	Negative			1			1	1												
2013ST -3	Both			1		1	1	1				1						1		
2013O S-1	Negative			1			1		1		1									
2013O S-2	Negative	1	1							1										
2013H C-1	Neutral			1				1			1							1		
2013H C-2	Neutral							1	1			1						1	1	
2013H C-3	Negative			1							1					1			1	
2013H C-4	Negative								1						1					
2013H C-5	Positive			1		1			1			1							1	
2013H C-6	Negative			1							1					1			1	
2013H C-7	Negative			1			1					1							1	
2013H C-8	Negative	1							1		1	1				1				
2013H C-9	Negative			1		1	1											1	1	
2013H C-10	Positive	1		1		1			1										1	1
2013H C-11	Neutral			1																
2013H C-12	Neutral			1																1

2013H C-13	Negative	1	1							1				1			
2013H C-14	Positive			1		1	1	1		1							1
2013H C-15	Positive			1		1											
2013H C-16	Negative	1							1					1			
2013H C-17	Both			1			1			1							1
2013H C-18	Negative	1							1								
2013H C-19	Negative	1		1					1	1			1	1			
2013H C-20	Negative			1		1					1						
2013H C-21	Neutral			1			1	1									
2012N Y-1	Negative	1	1	1	1			1		1						1	
2012N Y-2	Neutral			1			1	1									1
2012N Y-3	Positive			1		1											1
2012CT -1	Neutral							1		1							
2012CT -2	Negative	1												1			
2012CT -3	Negative	1	1						1					1			
2012CT -4	Neutral	1	1					1	1								
2012CT -5	Both	1	1														
2012CT -6	Neutral						1	1			1						1
2012CT -7	Negative	1	1						1								
2012CT -8	Negative				1				1								
2012CT -9	Negative	1	1						1	1				1			
2012CT -10	Negative	1					1	1	1					1			
2012ST -1	Positive			1		1		1									1

2012ST -2	Negative	1		1				1		1					1				
2012H C-1	Positive					1			1									1	1
2012H C-2	Both			1				1	1									1	
2012H C-3	Both			1			1	1	1									1	
2012H C-4	Negative			1			1	1				1							
2012H C-5	Both							1	1				1						1
2012H C-6	Negative			1			1					1							1
2012H C-7	Negative	1	1							1	1						1		
2012H C-8	Positive			1		1			1				1					1	
2012H C-9	Both			1				1											1
2011N Y-1	Neutral			1		1	1	1	1				1					1	1
2011N Y-2	Negative	1		1								1	1						
2011N Y-3	Negative	1					1				1							1	
2011N Y-4	Negative			1			1					1						1	1
2011N Y-5	Negative			1			1	1										1	
2011CT -1	Positive					1			1										
2011CT -2	Positive			1		1	1						1					1	
2011CT -3	Negative	1	1	1					1									1	
2011CT -4	Neutral	1																	
2011CT -5	Neutral	1																	
2011CT -6	Neutral	1							1										
2011CT -7	Negative	1													1			1	
2011CT -8	Negative			1			1	1				1							

2011ST -1	Neutral			1				1	1								1	
2011ST -2	Negative	1	1											1	1			
2011ST -3	Negative			1			1	1								1	1	
2011ST -4	Positive			1	1												1	
2011H C-1	Positive				1			1			1						1	
2011H C-2	Neutral				1			1									1	1
2011H C-3	Negative	1	1															
2011H C-4	Positive				1			1									1	
2011H C-5	Both	1			1	1	1	1		1	1	1						
2011H C-6	Negative	1		1				1		1						1		
2011H C-7	Positive			1	1			1									1	
2011H C-8	Neutral							1		1	1						1	
2010N Y-1	Negative			1	1	1	1										1	
2010N Y-2	Both			1	1	1	1			1							1	
2010N Y-3	Negative	1	1	1					1					1				
2010N Y-4	Negative			1			1	1									1	
2010CT -1	Negative	1	1						1	1				1				
2010CT -2	Both	1	1		1	1			1					1				
2010CT -3	Both	1	1	1	1	1	1			1				1	1			
2010CT -4	Negative			1			1	1				1						
2010ST -1	Negative	1	1						1	1				1				
2010ST -2	Positive			1	1				1								1	
2010ST -3	Negative	1							1					1				

2010ST -4	Negative			1			1	1			1						1	1
2010ST -5	Negative	1	1							1	1				1	1		
2010ST -6	Neutral			1		1			1								1	1
2010H C-1	Negative	1		1		1	1	1			1						1	1
2010H C-2	Positive					1			1			1						
2010H C-3	Negative	1		1			1	1			1					1		1
2010H C-4	Negative			1			1	1	1		1						1	1
2010H C-5	Negative	1	1							1	1					1		
2010H C-6	Positive			1		1			1								1	
2010H C-7	Positive			1		1			1			1					1	1
2010H C-8	Negative			1			1											
2010H C-9	Negative			1			1											
2010H C-10	Neutral			1				1									1	
2009N Y-1	Negative			1			1	1									1	
2009N Y-2	Negative			1				1			1						1	
2009N Y-3	Negative						1	1								1		1
2009N Y-4	Positive			1														
2009N Y-5	Both			1		1		1									1	
2009N Y-6	Negative	1	1		1					1								
2009N Y-7	Negative	1	1								1							
2009N Y-8	Negative	1	1															
2009N Y-9	Negative									1							1	
2009N Y-10	Negative	1							1							1		

2009N Y-11	Negative				1				1								
2009N Y-12	Neutral	1						1				1			1		1
2009CT -1	Negative	1	1	1				1	1	1	1				1		
2009CT -2	Negative			1				1	1						1		
2009CT -3	Both			1		1	1	1	1			1	1				1
2009ST -1	Negative	1													1		
2009ST -2	Positive			1		1			1								
2009O S-1	Negative	1	1	1	1			1									
2009H C-1	Positive					1											1
2009H C-2	Negative			1				1	1				1				
2009H C-3	Negative			1				1	1				1				
2009H C-4	Both			1		1	1	1				1					
2009H C-5	Both	1		1		1			1	1			1			1	
2009H C-6	Negative				1					1					1		
2009H C-7	Neutral			1					1				1				
2009H C-8	Positive			1		1	1	1									1
2009H C-9	Neutral					1			1			1					1
2009H C-10	Negative				1										1		
2009H C-11	Negative	1	1									1				1	
2009H C-12	Positive					1			1				1				
2009H C-13	Negative	1		1													
2009H C-14	Negative				1					1					1		
2009H C-15	Negative	1								1					1		

2009H C-16	Neutral			1		1			1							
2008N Y-1	Negative	1		1						1						
2008N Y-2	Negative			1		1										
2008CT -1	Negative					1				1					1	1
2008CT -2	Positive				1	1			1						1	1
2008CT -3	Both			1		1				1					1	
2008H C-1	Both			1		1	1	1		1						
2008H C-2	Positive			1		1		1								
2008H C-3	Negative	1	1							1				1		
2008H C-4	Both	1		1		1	1	1		1					1	1
2008H C-5	Neutral			1				1						1		
2008H C-6	Positive			1		1				1					1	
2008H C-7	Negative					1								1	1	
2007N Y-1	Negative	1		1		1				1					1	
2007N Y-2	Both	1		1		1	1	1		1				1	1	
2007N Y-3	Both	1							1					1		
2007N Y-4	Neutral			1				1							1	
2007ST -1	Negative			1		1	1			1				1		1
2007ST -2	Both	1							1					1		
2007H C-1	Positive					1								1		
2007H C-2	Positive	1		1		1								1		
2007H C-3	Positive			1		1			1						1	
2007H C-4	Positive			1					1						1	

2007H C-5	Negative																	1		
2007H C-6	Negative				1					1									1	
2007H C-7	Both				1					1									1	
2007H C-8	Negative				1					1									1	
2007H C-9	Positive	1																	1	

Figure 2: List of Articles Included in Final Data Set Database by Source & Title

New York Times:

2007	
Diet Supplements and Safety: Some Disquieting Data	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form&currentPosition=85&docId=GALE%7CA157626677&docType=Article&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA157626677&searchId=R4&userGroupName=mclin_c_worpoly&inPS=true
Give Us This Day our Daily Supplements	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form&currentPosition=94&docId=GALE%7CA160080381&docType=Article&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA160080381&searchId=R4&userGroupName=mclin_c_worpoly&inPS=true
F.D.A. Approves Vitamin Rules	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form&currentPosition=106&docId=GALE%7CA165485315&docType=Brief+article&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA165485315&searchId=R4&userGroupName=mclin_c_worpoly&inPS=true
Children's Supplements May Skew Research	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form&currentPosition=110&docId=GALE%7CA169860442&docType=Brief+article&sort=DA-ASC-

	SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA169860442&searchId=R4&userGroupName=mclin_c_worpoly&inPS=true
2008	
Potential For Harm in Dietary Supplements	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form¤tPosition=123&docId=GALE%7CA177579957&docType=Article&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA177579957&searchId=R4&userGroupName=mclin_c_worpoly&inPS=true
Study critiques Antioxidant Supplements	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form¤tPosition=127&docId=GALE%7CA178390963&docType=Brief+article&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA178390963&searchId=R4&userGroupName=mclin_c_worpoly&inPS=true
2009	
Regimens: Multivitamins Not Found to Reduce Risks	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form¤tPosition=149&docId=GALE%7CA193328767&docType=Brief+article&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA193328767&searchId=R4&userGroupName=mclin_c_worpoly&inPS=true
Vitamin Pills: A False Hope?	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form¤tPosition=151&docId=GALE%7CA193818361&docType=Article&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA193818361&searchId=R4&userGroupName=mclin_c_worpoly&inPS=true
Extra Vitamin E: no benefit, maybe harm	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form¤tPosition=153&docId=GALE%7CA196197308&docType=Article&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA196197308&searchId=R4&userGroupName=mclin_c_worpoly&inPS=true&autohCount=1&u=mclin_c_worpoly
Fish Oil Supplements can Contain Mercury	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-

	ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form¤tPosition=154&docId=GALE%7CA196197491&docType=Brief+article%2C+Photograph&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA196197491&searchId=R4&userGroupName=mclin_c_worpoly&inPS=true
As Economy is Down, Vitamin Sales Are Up	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form&currentPosition=156&docId=GALE%7CA197175999&docType=Article&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA197175999&searchId=R4&userGroupName=mclin_c_worpoly&inPS=true
Two Dietary Supplements Said to Contain Steroids	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form&currentPosition=11&docId=GALE%7CA204299927&docType=Article&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA204299927&searchId=R2&userGroupName=mclin_c_worpoly&inPS=true
Supplements for Athletes Draw Alert From F.D.A.	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form&currentPosition=12&docId=GALE%7CA204584784&docType=Article&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA204584784&searchId=R2&userGroupName=mclin_c_worpoly&inPS=true
F.D.A. Issues Warning on Supplements	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form&currentPosition=13&docId=GALE%7CA204584816&docType=Brief+article&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA204584816&searchId=R2&userGroupName=mclin_c_worpoly&inPS=true
A Focus on the Effects of Dietary Supplements Among Troops in War Zones	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form&currentPosition=15&docId=GALE%7CA207339631&docType=Article&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA207339631&searchId=R2&userGroupName=mclin_c_worpoly&inPS=true
Congress, Concerned	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form&currentPosition=15&docId=GALE%7CA207339631&docType=Article&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA207339631&searchId=R2&userGroupName=mclin_c_worpoly&inPS=true

About Steroids, Reviews Law on Dietary Supplements	esult- ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch- Form¤tPosition=18&docId=GALE%7CA208670271&docType=Article&sort=DA-ASC- SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA208670271&searchId=R2&userGroupName=mclin_c_worpoly&inPS=true
Focus on Supplements	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result- ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch- Form¤tPosition=27&docId=GALE%7CA213366011&docType=Brief+article&sort=DA-ASC- SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA213366011&searchId=R2&userGroupName=mclin_c_worpoly&inPS=true
Knowing what's worth paying for in vitamins	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result- ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch- Form¤tPosition=28&docId=GALE%7CA213574998&docType=Article&sort=DA-ASC- SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA213574998&searchId=R2&userGroupName=mclin_c_worpoly&inPS=true
2010	
Healthy Aging, With Nary a Supplement	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result- ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch- Form¤tPosition=30&docId=GALE%7CA216319833&docType=Article&sort=DA-ASC- SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA216319833&searchId=R2&userGroupName=mclin_c_worpoly&inPS=true
Vitamin D, Miracle Drug: Is it Science, or Just Talk?	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result- ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch- Form¤tPosition=33&docId=GALE%7CA217997350&docType=Clinical+report&sort=DA-ASC- SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA217997350&searchId=R2&userGroupName=mclin_c_worpoly&inPS=true
Herbal Supplements Commonly Have Traces of Contaminants, a U.S. Study Finds	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result- ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch- Form¤tPosition=37&docId=GALE%7CA227339378&docType=Article&sort=DA-ASC- SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA227

	339378&searchId=R2&userGroupName=mclin_c_worpoly&inPS=true
Extra Vitamin D and Calcium Aren't Necessary, Report Says	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form¤tPosition=5&docId=GALE%7CA243094034&docType=Article&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA243094034&searchId=R2&userGroupName=mclin_c_worpoly&inPS=true
2011	
Long and Shoer of Calcium and Vitamin D	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form¤tPosition=7&docId=GALE%7CA247399371&docType=Article&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA247399371&searchId=R2&userGroupName=mclin_c_worpoly&inPS=true
Deaths of 9 Alabama Patients Are Studied; All Got Intravenous Supplement	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form¤tPosition=11&docId=GALE%7CA252810079&docType=Article&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA252810079&searchId=R2&userGroupName=mclin_c_worpoly&inPS=true
Regimens: looking twice at supplements for infants	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form¤tPosition=16&docId=GALE%7CA255937243&docType=Brief+article&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA255937243&searchId=R2&userGroupName=mclin_c_worpoly&inPS=true
Support is Mutual for Senator and Makers of Supplements	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form¤tPosition=22&docId=GALE%7CA259343571&docType=Article&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA259343571&searchId=R2&userGroupName=mclin_c_worpoly&inPS=true
Prevention: Doubts on Women's Use of Supplements	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form¤tPosition=28&docId=GALE%7CA269305186&docType=Brief

	+article&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA269305186&searchId=R2&userGroupName=mclin_c_worpoly&inPS=true
2 Studies Offer Evidence on Risks of Vitamin Supplements	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form&currentPosition=29&docId=GALE%7CA269396774&docType=Article&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA269396774&searchId=R2&userGroupName=mclin_c_worpoly&inPS=true
2012	
Army studies workout supplements after deaths	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form&currentPosition=34&docId=GALE%7CA278820619&docType=Article&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA278820619&searchId=R2&userGroupName=mclin_c_worpoly&inPS=true
Healthy Women Advised Not to Take Calcium and Vitamin D to Prevent Fractures	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form&currentPosition=42&docId=GALE%7CA292903500&docType=Article&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA292903500&searchId=R2&userGroupName=mclin_c_worpoly&inPS=true
Multivitamin Use Linked to Lowered Cancer Risk	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form&currentPosition=46&docId=GALE%7CA305606799&docType=Article&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA305606799&searchId=R2&userGroupName=mclin_c_worpoly&inPS=true
2013	
The claim: Probiotic Supplements can Lower Cholesterol	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form&currentPosition=68&docId=GALE%7CA319253338&docType=Brief+article&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA319253338&searchId=R2&userGroupName=mclin_c_worpoly&inPS=true
U.S. Fines Vitamin C Producers in China	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-

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F.D.A. Issues Warning on Workout Supplement	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form&currentPosition=86&docId=GALE%7CA326050713&docType=Article&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA326050713&searchId=R2&userGroupName=mclin_c_worpoly&inPS=true
U.S. moves to seize Dietary Supplement from GNC warehouses	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form&currentPosition=97&docId=GALE%7CA334676779&docType=Article&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA334676779&searchId=R2&userGroupName=mclin_c_worpoly&inPS=true
Supplements Called Risky Are Destroyed	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form&currentPosition=100&docId=GALE%7CA336998231&docType=Brief+article&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA336998231&searchId=R2&userGroupName=mclin_c_worpoly&inPS=true
Skip the Supplements	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form&currentPosition=112&docId=GALE%7CA352930270&docType=Article&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA352930270&searchId=R2&userGroupName=mclin_c_worpoly&inPS=true
A Challenge to Vitamins	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form&currentPosition=113&docId=GALE%7CA353143585&docType=Article&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA353143585&searchId=R2&userGroupName=mclin_c_worpoly&inPS=true
Spike in Harm to Liver is	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form&currentPosition=114&docId=GALE%7CA353143585&docType=Article&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA353143585&searchId=R2&userGroupName=mclin_c_worpoly&inPS=true

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2014	
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A Supplement Retailer Pumps Up Consumers	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result- ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch- Form¤tPosition=140&docId=GALE%7CA365927689&docType=Article&sort=DA-ASC- SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA365927689&searchId=R2&userGroupName=mclin_c_worpoly&inPS=true
Hoping to Erase the Supplements Stigma	http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result- ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch- Form¤tPosition=147&docId=GALE%7CA373069641&docType=Article&sort=DA-ASC- SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA373069641&searchId=R2&userGroupName=mclin_c_worpoly&inPS=true
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Stores Told to Defend Supplement Assertions	<p>http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form&currentPosition=176&docId=GALE%7CA401175838&docType=Article&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA401175838&searchId=R2&userGroupName=mlic_worpoly&inPS=true</p>
What's in Your Supplements?	<p>http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form&currentPosition=177&docId=GALE%7CA401870449&docType=Article&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA401870449&searchId=R2&userGroupName=mlic_worpoly&inPS=true</p>
Vitamins Hide the Low Quality of Our Food	<p>http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form&currentPosition=178&docId=GALE%7CA401653645&docType=Article&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA401653645&searchId=R2&userGroupName=mlic_worpoly&inPS=true</p>
Vitamin-Packed with Promises	<p>http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form&currentPosition=179&docId=GALE%7CA403748340&docType=Book+review&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA403748340&searchId=R2&userGroupName=mlic_worpoly&inPS=true</p>
Retailers Adds Stricter Testing of Dietary Pills	<p>http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form&currentPosition=184&docId=GALE%7CA407510446&docType=Article&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA407510446&searchId=R2&userGroupName=mlic_worpoly&inPS=true</p>
Making Herbal Supplements Safer	<p>http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form&currentPosition=186&docId=GALE%7CA407769652&docType=Edit</p>

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Study Warns of Diet Supplement Dangers Kept Quiet by F.D.A.	<p>http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form&currentPosition=187&docId=GALE%7CA408751574&docType=Report&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA408751574&searchId=R2&userGroupName=mclin_c_worpoly&inPS=true</p>
Vitamin Stores to Stop Selling Supplements With Stimulant	<p>http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form&currentPosition=189&docId=GALE%7CA409028611&docType=Article&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA409028611&searchId=R2&userGroupName=mclin_c_worpoly&inPS=true</p>
Stimulant in Supplements Leads to Warning From U.S.	<p>http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form&currentPosition=191&docId=GALE%7CA410871362&docType=Article&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA410871362&searchId=R2&userGroupName=mclin_c_worpoly&inPS=true</p>
Dietary Supplements Cause 20,000 E.R. Visits Each Year, Study Says	<p>http://go.galegroup.com.ezproxy.wpi.edu/ps/retrieve.do?tabID=T004&result-ListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearch-Form&currentPosition=201&docId=GALE%7CA431602845&docType=Article&sort=DA-ASC-SORT&contentSegment=&prodId=SPN.SP24&contentSet=GALE%7CA431602845&searchId=R2&userGroupName=mclin_c_worpoly&inPS=true</p>
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