Self-Study and -Care of Human Health Problems Guided by New Scientific Mind Model

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Abstract: Unlike their physical health, individuals generally lack insight into their psychological/cognitive health which can also lead to body health problems. This blind spot, in addition to the stigma of seeking the help of mental health professionals, results in many disorders related first to brain and then to both body and mind. This ultimately requires extensive use of Prescription Drugs (PD) which focus on treating symptoms rather than cause of health problems. For Self-Study and -Care (SSC) of initial/emerging health problems, who is the decision maker for addressing health problems without using PD? While brain is in-charge of survival, mind is decision maker for anything and everything humans do.

This paper introduces and describes creative health approaches for SSC using new scientific model of mind which is an algorithm based on data generated along the Microbiome-Gut-Brain-Axis (MGBA). This is a valuable tool to study how brain areas act in concert to participate in a variety of cognitive processes including attention, learning, social cognition, and emotional states. For the first time, this study defines new scientific mind concepts of Complete Mind (CM), Emotional Mind (EM), Female Mind (FM) and Mirror Mind (MM) all of which affect the strategy used by a human for SSC with CM defined as an algorithm based on EEG (Electroencephalogram) data from MGBA. CM for females is same as FM except the latter also includes multitasking. When a human is under stress CM may be reduced to EM. CM is used for decisions regarding herbal remedies, reflexology, meditation, self-healing, environmental affects, food, stress, single-sensor FTIMS (Fabric- and Tattoo-Embedded Inexpensive Micro Systems) for data upload to a smartphone and analysis using MATLAB.

I.   INTRODUCTION

Current healthcare approaches, for most ailments, seem to focus on treating the symptoms rather than the root cause of many diseases leading to a worldwide rise of health problems related to brain, mind and body. Chronic inflammation [1][2][3] is the major cause of most health problems, especially chronic inflammation along the Microbiome-Gut-Brain-Axis (MGBA). While brain is in-charge of survival and not controllable by mind, mind is the decision maker for anything and everything humans can do. Thus, for Self-Study and -Care (SSC) of initial/emerging health problems, without using Prescription Drugs (PD), the decision maker for addressing health problems is mind. This paper introduces and describes creative health approaches for SSC using new scientific model of mind which is an algorithm based on Electroencephalogram (EEG) and Electrogastrogram (EGG) data generated along MGBA [4]. For example, attention level algorithm R is defined by $R=E_\alpha/E_\beta$, where E_α and E_β are density functions for alpha and beta waves, respectively [5].

The data generated along MGBA is strongly affected by childhood memories or Amygdala Scripts (AS) [6]. Such approaches are not only valuable for SSC but also a valuable tool to study how MGBA areas act in concert to participate in a variety of cognitive processes including attention, learning, social cognition, and emotional states such as anxiety.

This paper, for the first time, defines new scientific mind concepts of Complete Mind (CM), Emotional Mind (EM), Female Mind (FM) and Mirror Mind (MM) all of which, as algorithms, affect the strategy used by a human for SSC with CM based on EEG data from MGBA. CM for females, with multitasking capability, is defined as FM. When a human is under stress CM is reduced to EM affecting strongly the human strategy/judgments used for SSC.

II.   DEFINITION OF DIFFERENT STATES OF MIND

Brain has 86 billion neurons [7] out of which 99 % are in cerebral (16 billion) and cerebellar (69 billion) cortexes [8] [9]. Pre-Frontal Cortex (PFC) has10 billion neurons. PFC, amygdala, cerebellum, and other parts in MGBA are used to define CM as shown in Fig. 1 (a). In addition to its motor role, the cerebellum is involved in cognitive, affective, social, and emotional processing [10] and with its 69 billion neurons [9] acts as the computational unit of the brain. The scientific

model of mind which is an algorithm based on EEG and Electrogastrogram (EGG) data generated along MGBA [4], is the decision maker and leader of everything and anything the living humans and non-humans do and feel.

Complete Mind (CM) results if all parts in Fig. 1 (a) are generating EEG/EGG data and Microbiomes, through communication with Amygdala, are generating additional EEG data. If any of the parts listed above are not fully functional, the mind becomes Incomplete Mind (IM). As shown in Fig. 1 (b), the lack of PFC function results in Emotional Mind (EM). Thus, fight between two animals ends when one runs away or dies leading to the fact that animal mind (AM), except monkeys, is fully EM. If a human is under extreme stress, as shown in Fig. 1 (c), the PFC (with largest size in humans) is partially or fully shutdown by brain due survival reasons, the result is EM. As shown in Fig. 1(c), the released stress hormones lead to several symptoms (blue boxes).

As healthy females have higher rates of cerebral blood flow than males [11], women are better in multitasking [12]. Thus, Female Mind (FM) is defined as CM with more active prefrontal and limbic regions. This difference seems to be related to life of early humans. When humans and animals learn by watching an action, additional neurons, called mirror neurons [13], become active leading to Mirror Mind (MM). The mind states of CM, EM, IM, FM and MM are defined for the first time in this paper. For Self-Study and -Care (SSC) of initial/emerging health problems, ideally CM is needed. FM seems more effective for SSC as females live longer [14][15] and are better in multitasking [12].
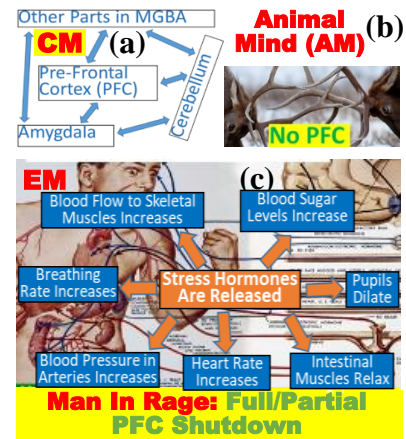

Fig. 1 *Complete mind model (a), animal with no PFC (b) and human emotional mind (c).*

III. EFFECTS OF CM ON CHRONIC INFLAMMATION

The Diet, Environment, Exercise, Prescription-medicine, Sleep and AS (DEEPSA), in a complex manner, affect stress and chronic inflammation levels. The fundamental personality dependent data, generated by the limbic system in general and Amygdala in particular, affects mind. Thus, the data from Amygdala [6][16], PFC and Cerebellum play a fundamental role in defining the personality, differentiating one human from another. CM or FM can help avoid or eliminate chronic inflammation, EM (Emotional Mind) will increase inflammation, and MM will help learn watching others using CM/FM as shown in Fig. 2 which shows DEEPSA model. Diet can contain chemicals, antibiotics, Genetically Modified Organism (GMO), lectins unless it is organic. The environment consists of pollution, trees, lawn, and people. Trees, in addition supplying oxygen, are source of chemicals in polluted areas. A beautiful lawn may satisfy ego/amygdala of a human, but it supplies dangerous chemicals unless an organic fertilizer is used.

People under extreme stress spread stress for those who socialize with them through a process related to mirror neurons [13]. For example, certain parts of brain of person A under extreme stress are very active and when this person socializes with person B neurons in similar parts of person B's brain are also activated bringing person B also under stress. The activated neurons in person B's brain are called mirror neurons. Thus, mirror neurons are involved in stress infection from human to another.

Fig. 2 *Suggested model of interrelated factors affecting chronic inflammation controllable by mind.*

Exercise is considered 2nd best medicine for all diseases. Prescription medicine has side effects, is inflammatory and habit forming. Sleep is crucial for good health and repairs body & brain. Amygdala Scripts (AS) [6] determine personality and affect behavior. Consequently, the root cause of most diseases/conditions is an extremely complex problem requiring a complex study approach as shown in Fig. 2. The chronic inflammation in MGBA can be affected, positively or negatively, by DEEPSA (Fig. 2). While the stress affects the chronic inflammation directly, the behavior, normally related to AS, is the major factor affecting stress making the cause of health problems very complex. The stress hinders generation of new neurons.
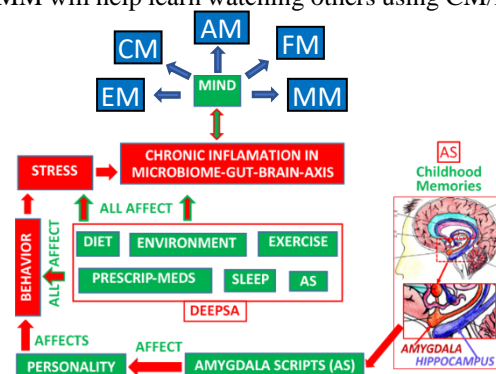
IV. CM/FM CAN AFFECT NEUROGENESIS

Interestingly, the only area of the brain where neurogenesis (ability to make new cells) continues throughout life is the hippocampus, an area essential to memory encoding and storage. Neurogenesis increases by learning, exercise [17][18] and sex but decreases with stress, sleep deprivation and aging. CM/FM affect aging by controlling stress [19]. The slowdown of biological aging by slowing the shortening of DNA telomere through diet, exercise and good sleep is possible [20]. CM/FM controls diet, exercise, and good sleep. Amygdala Scripts [21][22][23], permanently stored in hippocampus, affect mind and personality. AS can affect neurogenesis through stress. There is some evidence that neurogenesis can also take place in midbrain and striatum [24] areas. Decision making is affected by Amygdala [25][26][27] and PFC. The Microbiomes, communicating with amygdala [23] through vagus nerve, affect stress and neurogenesis.

Normal inflammation is body's self-healing response to kill damaging agents and is crucial for survival. However, chronic exposure to a variety of antigens induces a chronic low-grade inflammatory status (so called 'inflammaging') that contributes to age-associated morbidity and mortality [1]. The key to successful aging and longevity, for all ages, is to *decrease chronic inflammation without compromising an acute response when exposed to pathogens*. This is because in later life, chronic inflammation can lead to a number of chronic diseases such as atherosclerosis [2][3], type 2 diabetes [28][29], Alzheimer's disease [30], multiple sclerosis [31][32], and osteoporosis [33][34]. Major depression and frailty (common in the elderly) have a major inflammatory component [35][36]. CM (Complete Mind) can help select diet/herbs to help cope with such problems

Recent research shows that chronic inflammation problems can occur anywhere along MGBA [37][38][39]. As the gut is the longest and complicated body part (one of the three body parts along with skin and lungs directly exposed to the outside environment), understanding the implications of its exposure to the outside world and related chronic inflammation is a huge challenge. For example, the antibody immunoglobulin (Ig) is involved in food intolerance (IgG) and food allergy (IgE). IgG, the most common antibody in circulation in human blood (approx. 75 %) [40], causes Irritable Bowel Syndrome (IBS) and other problems because certain foods have antigens incompatible with IgG [41]. Also, the emotional problems [40], mediated by amygdala scripts [6], become dominant because the PFC (pre-frontal-cortex), being a newer part of the brain, is more susceptible to psychological and physiological cognitive damages [42]; particularly for elderly [43] health. Again, CM/FM can help in these situations.

V. HOW DO BRAIN AND MIND WORK TOGETHER?

To understand how brain works and why an impaired or partially impaired PFC could be a major problem for the humans consider this example. A human having a walk in the woods makes a sudden turn and spots a curvy object on the ground. How does the human brain decide whether this object is a threat, an opportunity or neutral [44]? In the first few tenths of a second after the object is sited, a visual signal, entering the occipital cortex of the brain, is transmitted to (a) hippocampus (for a quick evaluation by comparing it to objects on its danger list) and (b) to amygdala which promptly communicates with PFC (that performs a sophisticated analysis) and other parts of the brain. Even if in this example, the object turns out to be a stick, the brain must go through all the necessary processes to decide whether fight, freeze or flight is required.

Although, the reaction to situations like one mentioned above will be similar for all human beings in general, brain of a human under stress may simulate the 'fight, freeze or flight' behavior even for normal situations sensitivities including phobias/fears of getting (i) diseases, (ii) hurt, and (iii) anxiety/depression generating further stress. The PFC is most sensitive to the detrimental effects of stress exposure [45][46][47]. This is because the PFC, the most evolved brain region with the highest-order cognitive abilities, is more susceptible to impairment in contrast to older subconscious limbic system of the brain (with amygdala being the emotional center). Even quite mild acute uncontrollable stress can cause a rapid and dramatic loss of PFC cognitive abilities while a prolonged stress exposure causes architectural changes in PFC dendrites [45]. Consequently, an amygdala-mediated or emotional behavior can lead to IM or EM Incomplete and Emotional Minds).

Recent research reveals intracellular signaling pathways that mediate the effects of stress on the PFC [45] leading to symptoms of profound PFC dysfunction as seen in Fig. 1(c). However, the environmental effects dominate according to "genes load the gun, the environment pulls the trigger" [48]. How can the performance of PFC be made more effective to counteract the negative influence of amygdala and amygdala scripts in humans? It is interesting to note that in a normal

breathing process only medulla is involved, and PFC plays no role. Yoga and meditation exercises (e.g., mindfulness) with carefully designed breath-in and –out cycles involve activating PFC's role in relaxing [49][50] and minimizing amygdala's stressful emotional role. The involvement of PFC can help eliminate the false positives for the 'fight, freeze or flight' response by amygdala.

VI.   FABRIC- AND TATTOO-EMBEDDED INTEGRATED MICRO SYSTEMS (FTIMS) AND SMARTPHONES

This study focuses (Fig. 3) on (a) a holistic approach to collect mind/body data along MGBA using Fabric- and Tattoo-embedded Integrated Micro Systems (FTIMS) and smartphones, (b) thousands of years old meditation and herbal therapies and remedies that tend to cure the cause of health problems without the side effects, (c) SSC and (d) algorithm development for CM, EM, FM and MM.

The unique features presented in research are (i) education and understanding of effects of aging and meditation/herbs to study how cognitive impairment of PFC causes chronic inflammation due mainly to stress and chemicals in environment, (ii) fabrication and testing of 24-hour-wearable FTIMS to upload brain/body data to a smartphone and use MATLAB Mobile to analyze data, (iii) studying how exercise, food, herbal remedies and environment can affect human wellbeing as monitored by wearable systems mentioned in, (iv) link among glucose, cholesterol and urid acid, and (v) educating the current human generation as well as prepare the next generation with smart tools/apps available today.

Fig. 3 *Fabric-embedded FTIMS; EEG data into a smartphone (a, b), and mind-controlled LEGO robot (c) [51].*

In the current/prior work (as shown in Figs. 3), single-EEG-sensor FTIMS embedded in a cap, wig, jacket, and shirt collar were tested. While FTIMS are mostly based on off-the-shelf components, the use of a sewing machine to fabricate 80-micrometer-thick Cu-wire-based EEG sensors is a creative feature of this work. The cap-mounted FTIMS led to design and testing of a mind-controlled robot [51] a technology applicable to FTIMS for in-home brain/body SSC for health monitoring using smartphones (useable in smart-homes). The tattoo-embedded part of FTIMS will be addressed in future.

VII.   GLUCOSE, CHOLESTEROL, URIC ACID, HERBS, TEA, YOGA, AND REFLEXOLOGY.

A female (multitasking [12]) and a male (focus on one problem) would form a perfect union for smart health if they possess CM and FM. They can jointly accomplish health and happiness leading to healthy and long life. However, if one of them is under stress not having CM, the stress will infect the other by mirror neurons as mentioned in section III. Herbs, Yoga, and reflexology can help reduce stress along the MGBA.

Recent research indicates link between glucose, urid acid and cholesterol [52][53][54]. Using CM, one can limit glucose levels that also reduce cholesterol [53] and uric acid [54]. The key factor is replacement of sugar by healthy alternatives. Green and black tea [55] consumption is correlated with a low incidence of cardiovascular disease and cancer for which oxidative stress plays a critical role.

The fMRI (functional magnetic resonance imaging) scans are being used to monitor the efficacy of *stress*-reducing Yoga meditations [56][57]. With the availability of smartphone Apps and inexpensive wearable biomedical devices the efficacy of *Yoga and reflexology therapies* can be monitored. Smartphones and FTIMS can be used to monitor the efficacy of anti-inflammatory herbs such as *coconut, hemp seeds*, *curcumin,* and *black seeds* (nigella sativa) that have been the subject of hundreds of recent studies because of their effectiveness in curing chronic inflammation-related mind and body health problems.
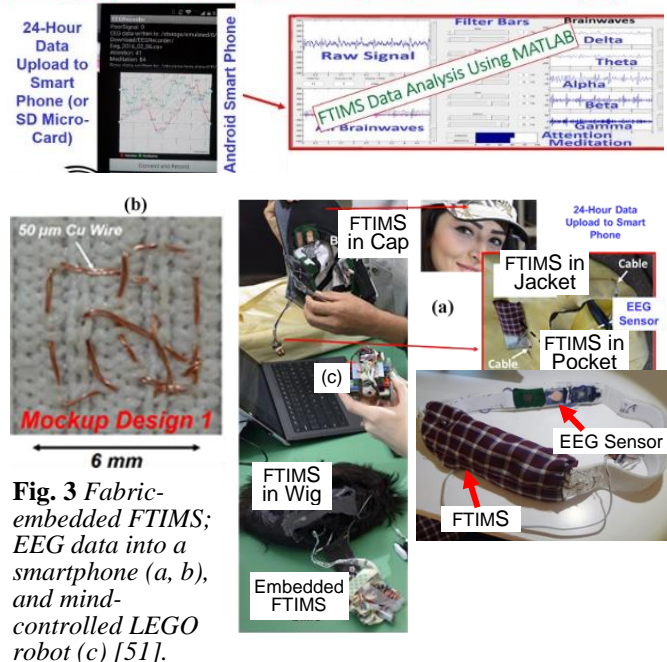
The new *exciting research* on (a) slowdown of *telomere-related cell division* [58] that is possible through the control of environment and (b) *activation of sleeping stem cells* that, if awakened, can reverse the aging [58] because these *reveal* remarkable benefits for humans if the stress, environment, exercise and diet are managed properly using CM/FM (Complete Mind/Female Mind). Algorithms for the prediction of depression [59] and other health problems (important for *in-home healthcare*) have also become the focus of recent research. *Algorithm development, which requires data collection and storage, can be done using FTIMS and Smartphone Apps*.

Exercise, Yoga and Reflexology: The efficacy of (a) exercise, (b) Yoga and (c) hand, foot, and face reflexology [60] self-massages can be studied by smartphone Apps related to these three areas. Exercise increases energy and oxygen levels. All three reduce the stress levels enhancing the PFC functionality. For examples, foot massage for one minute on each foot 2-3 times a day reduces daily stress indicated by better flow of urination. Examples of reflexology Apps include 'reflexology charts', 'reflexology tutorial', 'reflexology secrets', etc. Similar Apps for Yoga can be found and used. Examples mentioned are only related to reflexology. Some Yoga related educational Apps should also be mentioned. It is a well-accepted fact that yoga and exercise are good for mental and physical health. Easy yoga breathing, simple pose yoga, etc., can be used.

Healing Herbs: Herbs can boost body's self-healing power to fight number of diseases including cancer [61]. In fact, the brain and body are optimized by the evolution to self-heal [62]. Mat with healing herbs and 'Herbs and Saints in the City of Angels' [63] are available. Specific benefits of the herbs are described below:

1. Curcumin: Many high-quality studies show that curcumin, the most important curcuminoid found in turmeric, has major benefits for body and brain health [64][65]. Although, curcumin has powerful anti-inflammatory and antioxidant properties, it is found only approximately 0.3 % in turmeric [66]. Thus, an extract that contains significant amount of curcumin is used. The problem of curcumin's poor absorption in bloodstream is solved by using piperine (found in black pepper) that increases the absorption of curcumin by 2000 % [67]. Another solution of the absorption problem is to use curcumin extract called BCM-95 that is more effective and stays longer in the system [68]. In its anti-inflammatory role, curcumin is so powerful that it matches the effectiveness of some anti-inflammatory drugs [69]. Curcumin is a bioactive substance that fights inflammation at the molecular level [70]. In several studies, its potency has compared favorably to anti-inflammatory pharmaceutical drugs except without the side effects [71]. Curcumin is not only a potent antioxidant that can neutralize free radicals due to its chemical structure [72] but boosts the activity of the body's own antioxidant enzymes [73]. In that way, curcumin blocks the free radicals directly and then stimulates the body's own antioxidant mechanisms. Further benefits of curcumin are [74]:

a)   It boosts brain-derived neurotrophic factor that is linked to improved brain function and a lower risk of brain diseases.
b)   Curcumin leads to various improvements lowering the risk of heart disease.
c)   It can prevent/treat cancer.
d)   Curcumin may be useful in preventing and treating Alzheimer's disease.
e)   Arthritis patients respond very well to curcumin supplementation.
f)   Curcumin, with incredible benefits against depression, can be as effective as prozac (Fluoxetine) without the side effects of prozac.
g)   Curcumin may delay aging and fight age-related chronic diseases.

2. Black Seeds (nigella sativa): With 630 scientific peer-reviewed articles [75] that have been published about black seed oil benefits and with virtually no side effects, the healing power of black seeds is quite unbelievable [75]:

a)   It lowers the blood pressure and enhances testosterone level (which go down with age as shown in Fig. 4). Enhancing testosterone levels (T-levels) in humans leads to number of health benefits including desire to do things, forward looking attitude, and a stronger bone structure.

b)   Blackseed and honey increase T-levels. For example, a person in the age group of 65-74 years, experienced 20-25 % increase in his total testosterone level (and increased sexual activity) after using blackseed for 4 weeks [76].

c) Black seeds oil contains thymol, Thymoquinone (TQ) and thymohydroquinone (THQ) that are effective against 30 human pathogens. TQ was the best antifungal compound against all tested dermatophytes and yeasts, followed by THQ and thymol.

d) Effective against Apathy, Alzheimer's disease, Autism, Glaucoma, Dementia, Myasthenia gravis, Neurodegenerative conditions, Postural Tachycardia Syndrome, Schizophrenia, Parkinson's disease.

Age	Total T (ng/dl)	Free T (pg/ml)	SHBG (ug/ml)	DHEA-S (ug/dl)	Estradiol (pg/ml)
25-34	617	123	4.0	236	37.3
35-44	668	103	4.5	221	36.5
45-54	606	90	5.0	177	38.7
55-64	562	83	5.1	118	35.1
65-74	524	69	5.5	96	36.0
75-84	471	60	5.7	44	37.9
85-100	376	54	7.4	44	37.1

Fig. 4 *Age-dependent testosterone levels:* https://www.menshormonalhealth.com/normal-testosterone-levels.html

e) It is used as a tuberculoid and virucides to kill tuberculosis (TB) and various viruses.

f) Used in medical and general-purpose disinfectant, rapidly degrading, non-persisting pesticide.

g) Used in food flavorings, perfumes, mouthwashes, and even cosmetics.

h) It sounds to CM (Complete Mind), that black seeds are cure for every disease except death!

3. Hemp Seeds (Cannabis sativa): They are rich in healthy fats and essential fatty acids [77][78]. It is a highly nutritious food and contains antioxidants, protein, carotene, phytosterols, phospholipids, as well as several minerals including calcium, magnesium, sulfur, potassium, iron, zinc, and phosphorus. It contains all twenty known amino acids, including the nine essential amino acids. It also contains chlorophyll, vitamins A, B1, B2, B3, B6, C, D, and E. Its 3:1 ratio of Omega-6 to Omega-3 fatty acids promotes the heart health [79] and its nutrients in the oil may help prevent number of degenerative diseases [80]. Studies have indicated that hemp seed oil can dramatically decrease skin dryness to alleviate itching and irritation [81]. Antioxidant and anti-inflammatory properties may protect against the aging process while soothing the skin [82]. Hemp seed oil contains essential fatty acids, including docosahexaenoic acid (DHA), that are required for brain development. DHA is crucial to the health of the brain as well as the retina of the eye, particularly in the first year of life [83]. Hemp seed oil works as a terrific alternative to traditional omega-3 fatty acid supplements and does not carry the same risk of mercury ingestion [84] as in fish. The essential fatty acids in hemp seed oil have been shown to promote healthy flora in the intestines and immune function [85]. *Hempseed side effects:* The oil in hempseeds may show blood clotting interacting with blood thinners. Due to its high fiber content, digestive symptoms like diarrhea, constipation or gas may occur if eaten large quantities of hempseeds. It is highly unlikely, but possible, to experience THC (Tetrahydrocannabinol) side effects from eating hempseeds. Symptoms may include hallucination or euphoria. However, if hempseeds are from a reputable source, this should not be an issue.

4. Coconut oil: It contain MCTs (medium chain triglycerides) that provide high energy levels without increasing the cholesterol levels. It has a number of scientifically proven benefits [86]: Coconut oil can help brain disorders, increases weight loss, builds muscle, can help fight infections, helps reduce abdominal fat, curbs appetite lowers risk of heart disease, increases metabolism, protects hair against damage, anti-dandruff, moisturizes skin, acts as sunscreen, prevents gum disease and tooth decay, helps candida/yeast infections, protects your kidney and liver, treats kidney and bladder stones, reduces inflammation and arthritis, cancer prevention and treatment, reduce seizures, improves digestion, reduce symptoms of gall bladder disease and pancreatitis, prevents osteoporosis, hormone balance, stress relief, anti-aging benefits, supports thyroid functioning, eliminates free radicals damage, helps improve type 1 diabetes.

5. Ginkgo Biloba: It has been the subject of 300 hundred research papers by German researchers and is a prescription drug in Germany. It is used for the treatment of numerous conditions but available evidence supports *ginkgo for managing dementia, anxiety, schizophrenia, and cerebral insufficiency (insufficient blood flow to brain)* [87][88][89][90].

6. L-Theanine: L-theanine can promote mental health by reducing stress-related ailments and cognitive impairments [91]. Study suggests that L-theanine is safe and beneficial for depression, anxiety, sleep, and cognitive impairments in patients [92].

7. Nuts: There is compelling evidence that nut intake protects against cardiovascular disease (CVD), risk of coronary heart disease, myocardial infarction, sudden death, and stroke through improvement of lipid and apolipoprotein profile. Nut consumption lowers oxidative stress, inflammation, and endothelial function. Unsaturated fatty acids, L-arginine, beneficial minerals, phenolic compounds and phytosterols in nuts improve health [93] [94]. Complex carbohydrate and

unsaturated fat mostly as monounsaturated fatty acids (MUFA; predominantly oleic acid) and polyunsaturated fatty acids (PUFA) which are primarily found in walnuts (linoleic acid, 18:2n-6andα-linolenic acid, C18:3n-3) [95][96]. Macadamia nuts, with highest Omega-3 to Omega-6 ratio, contain palmitoleic acid that is an omega-7 monounsaturated fatty acid reducing inflammation, preventing diabetes and cardiovascular disease [97]. Brazil nuts, with high amounts of selenium, are antidepressants [98].

VIII.   CONCLUSIONS

This paper introduces and describes creative health approaches for SSC (self-study and -care) using new scientific model of mind which is an algorithm based on data generated along the Microbiome-Gut-Brain-Axis (MGBA). This is a valuable tool to study how brain areas act in concert to participate in a variety of cognitive processes including attention, learning, social cognition, and emotional states. For the first time, this study defines new scientific mind concepts of Complete Mind (CM), Emotional Mind (EM), Female Mind (FM) and Mirror Mind (MM) all of which affect the strategy used by a human for SSC with CM defined as an algorithm based on data from MGBA. CM for females is same as FM except the latter also includes multitasking. When a human is under stress CM may be reduced to EM. CM is used for decisions regarding herbal remedies, reflexology, meditation, self-healing, environmental affects, food, stress, single-sensor FTIMS (Fabric- and Tattoo-Embedded Inexpensive Micro Systems) for data upload to a smartphone and analysis using MATLAB.

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