



Membrane Lipid Replacement—a functional approach to repairing cellular membranes, reducing symptoms, and restoring function

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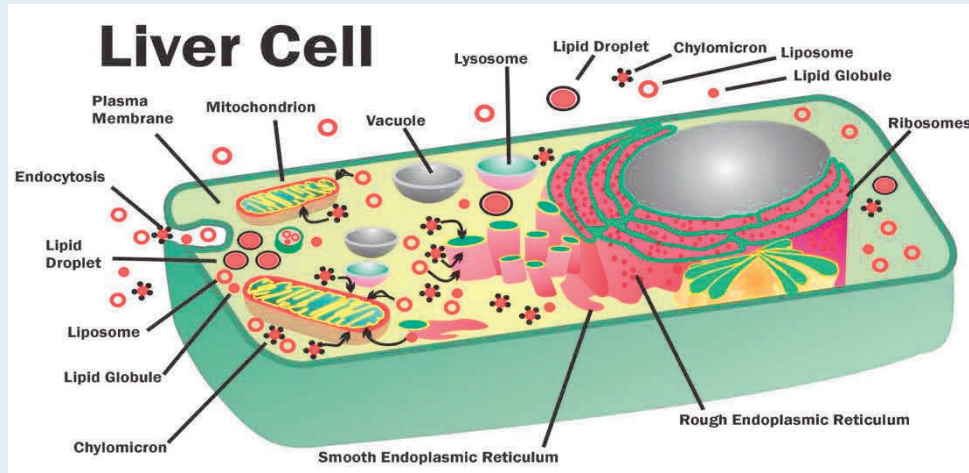
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ABSTRACT

Membrane Lipid Replacement (MLR) uses natural, protected membrane lipid supplements to safely replace damaged, oxidized lipids in cellular membranes in order to restore membrane function, decrease various symptoms and improve health. Membrane injury occurs in essentially all chronic and acute medical conditions as well as in normal aging and development. The repair of damaged cellular membranes, and the removal of impaired membrane lipids and other toxic molecules from cells, are essential to recovery and health. Clinical studies have demonstrated the advantages of MLR in restoring membrane and organelle function and reducing fatigue, pain and other symptoms in chronic illnesses and aging patients. MLR has also been used in in vitro studies to demonstrate its ability to increase cell motility and resistance to oxidative damage. It also has the ability to enhance the bioavailability of other nutrients and their transport across intestinal epithelial cell barriers.

Keywords: membrane phospholipids, lipid transport, lipid oxidation, mitochondrial function, fatigue, pain, chronic disease symptoms, aging



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INTRODUCTION

Membrane Lipid Replacement (MLR), the use of all-natural, protected, plant-sourced oral membrane lipid supplements to safely replace damaged, oxidized lipids in cellular membranes, can restore membrane and organelle function, decrease chronic symptoms, and improve health outcomes [1-5]. MLR supplements fit the definition of functional foods and contain mixtures of cell membrane glycerolphospholipids, fatty acids, and other lipids that are protected by fructooligosaccharides and antioxidants [1-3]. Once ingested, the MLR phospholipids are transported to tissues and cells where these MLR lipids can replace and remove damaged intracellular and cellular membrane lipids as well as other hydrophobic toxic molecules from cells and tissues [3,5,6].

Membrane injury, caused mainly by free radical oxidative damage, occurs in essentially all chronic and acute medical conditions, including cancers, degenerative diseases, environmental exposures, and in

normal processes, such as aging and development [4-7]. After ingestion, the protected MLR glycerolphospholipids and other lipids are dispersed, absorbed, and internalized in the small intestines, where they can be subsequently transferred, exchanged or partitioned into circulating lipoproteins, liposomes, micelles, and membranes of circulating cells and other lipid carriers. They are then transported in the lymphatics and blood circulation to tissue and cellular sites where they are taken in by cells using various transport mechanisms. Once inside cells, the MLR glycerolphospholipids and other lipids are conveyed by concentration-dependent partitioning into various intracellular membranes mediated by lipid carriers, lipid globules, liposomes, chylomicrons, or by direct intracellular membrane-membrane interactions [2,3,5]. The entire process appears to be driven by 'bulk flow' or 'mass action' principles, where surplus concentrations of replacement lipids can stimulate the natural exchange and removal of damaged membrane lipids. The replacement lipids can

undergo further enzymatic alterations at their ultimate cellular membrane sites to reflect the lipid compositions at these sites [2,5,8].

CLINICAL STUDIES

Human studies have demonstrated the advantages of MLR in restoring membrane and organelle function, reducing fatigue, pain, and other symptoms in chronic illness and aging [1-7]. For example, the use of MLR supplementation to improve age-related symptoms in middle-aged, pre- and post-menopausal women was investigated in a randomized, double-blind, placebo-controlled study [9]. The study subjects, post-menopausal women, complained of fatigue but were otherwise relatively healthy. The participants in this clinical trial were given MLR with NTFactor Lipids or placebo for 4 or 8 weeks, and fatigue, vigor, mood, and various menopause symptoms were monitored. The women that received 1.2 g per day NTFactor Lipids showed greater reductions in fatigue compared to placebo, and there were significant improvements in patient vigor. Sleep, confusion, anger, and menopausal symptoms were evaluated using Quality of Life instruments and showed improvements in the MLR group. Cardiovascular parameters were also examined, and in the MLR group there were reductions in diastolic blood pressure and improvements in cardio-ankle vascular index [9].

A recent use of MLR in environmental illnesses was initiated for chemically exposed war veterans [6,10]. Many veterans of the first Gulf War returned and slowly displayed multiple signs and symptoms related to their

deployment and environmental exposures. The multi-symptom chronic illnesses associated with this war have been called Gulf War Illness(es) (GWI) [11,12]. Some GWI patients appear to have their illnesses linked to chemical exposures, such as oil spills and fires, smoke from military operations, chemicals on clothing, and exposures to pesticides, chemoprophylactic agents (pyridostigmine bromide), chemical weapons, and other possible chemicals [13,14].

We first initiated case studies on veterans of the Gulf War that reported a variety of signs and symptoms that were related to their chemical exposures. These case studies indicated that MLR could improve clinical status by reducing symptoms, such as fatigue, pain, and other symptoms [10]. Next, a clinical study was initiated using oral NTFactor Lipids (6 g per day) to see if veterans' self-reported multiple symptom severities improved with time while on the oral MLR supplement. In this study there were gradual and significant reductions in symptom severities related to fatigue, pain, musculoskeletal, nasopharyngeal, breathing, vision, sleep, balance, gastrointestinal symptoms, chemical sensitivities, and other symptom categories during the 6-month study [6].

Other examples of the use of MLR in various health and clinical conditions are listed in Table 1. What is notable about the potential uses of MLR in humans is that these conditions span multiple situations, from common conditions like obesity and aging to various degenerative and metabolic diseases and cancers. What is clear from these studies is that MLR can also be a useful addition to conventional medical treatments for a number of

commonly found illnesses and conditions to repair damaged cellular membranes and in the process reduce

the severities of a variety of chronic signs and symptoms as well improve general health [1-5].

Table 1. Current and potential uses of oral MLR supplements and revised suggested daily dose levels.^a

Use/condition	Subjects/patients	Age	MLR type	NTFL dose ^b	Example
		Group	Supplement	Range (g/day)	Reference(s)
General health	aged	senior	NTFactor/L ^c	2-3	Nicolson et al. [4]
Fatigue	Aged	senior	NTFactor/L	4	Agadjanyan et al. [15]
Fatigue	CFS/ME	adult/teen	NTFactor/L	4	Nicolson & Ellithorpe [16]
Fatigue	CFS/ME	adult	ATP Fuel	4	Nicolson et al. [17]
Inflammation	Chronic fatigue	adult	ATP360	N/A ^d	Hamilton & Jensen [18]
Fatigue	Fibromyalgia	adult	NTFactor/L	4	Nicolson et al. [19]
Fatigue	Menopause	senior	NTFactor/L	2	Hirose et al. [9]
Weight loss	Obesity, fatigue	adult	NTFactor	2	Ellithorpe et al. [20]
Brain health	Neurodegen. dis	adult	NTFactor/L	4	Nicolson et al. [21]
CD health	CD risk/CD dis.	adult	NTFactor/L	3-4	Ellithorpe et al. [22]
Metabolic health	MetSyn/diabetes	adult	NTFactor/L	3-4	Nicolson [23]
Metabolic health	Diabetes	adult	ATP Fuel	3-4	Nicolson et al. [17]
Neurobehavior	Autism Spectrum dis.	child	NTFactor/L	1-3	Nicolson et al. [3]
Infections	Lyme/mycoplasma	adult	ATP Fuel	4	Nicolson et al. [24]
Fertility	Fertility Diseases	adult	NTFactor/L	3-4	Ferreira et al. [25]
Fatigue	Cancer	adult	NTFactor/L	3-4	Nicolson [26]
Anemia	Anemia	adult	NTFactor/L	3-4	Nicolson et al. [3]
Injury	Spinal injury	adult	NTFactor/L	3-4	Ellithorpe et al. [12,123]
Autoimmune	Rheumatoid arthritis	adult	ATP Fuel	4	Nicolson et al. [12,123]
General health	Pregnancy	adult	NTFactor/L	2-3	Ellithorpe et al. [27]
Chemical detox	GW Illnesses	adult	NTFactor/L	6	Nicolson & Breeding [6,10]

^aModified from Nicolson et al. [5]. Abbreviations: CD, cardiovascular disease; CFS/ME, chronic fatigue syndrome/myalgic encephalomyelitis; GW, Gulf War; MetSyn, metabolic disease/syndrome; MLR, Membrane Lipid Replacement; N/A, not applicable; NTFL, NTFactor Lipids;

^bSuggested revised dose range in grams per day based on NTFactor Lipids[®]

^cNTFactor[®] or NTFactor Lipids[®]

^dNot Available

OTHER STUDIES

MLR lipids have been used to demonstrate the role of membrane integrity in maintaining cellular function. For example, NTFactor Lipids® can repair mitochondrial membranes and restore mitochondrial function in human cells [15]. MLR has also been used to repair spermatozoa membranes and increase the motility of sperm and resistance to oxidative damage [25,28].

Finally, MLR can improve the transport and bioavailability of nutrients not associated with MLR ingredients. Using an intestinal epithelial bioabsorption tissue culture model based on the transport of nutrients across a monolayer of human intestinal Caco-2 cells, NTFactor Lipids® was found to increase the transport and bioavailability of three test nutrients (coenzyme Q10, curcumin and quercetin) [29]. Therefore, in addition to its own abilities to improve health outcomes, MLR has the potential to improve the bioavailability and properties of various other nutrients that could also be beneficial to health [29].

CONCLUSION

Clinical trials have shown the efficacy and usefulness of MLR supplements in reducing symptoms associated with loss of mitochondrial and other cellular functions and improving the quality of life in patients with a variety of chronic illnesses and normal age-related loss of function. Recent efforts have focused on the effects of MLR supplements on reducing pain, gastrointestinal and other symptoms as well as age-related functional loss. MLR can also improve the bioavailability of certain nutrients and improve membrane function and cellular properties, such as cell motility [25,28].

List of Abbreviations: GWI, Gulf War Illnesses; MLR, Membrane Lipid Replacement

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Competing Interests: The author is a part-time consultant to Nutritional Therapeutics, Inc. of New York, NY and Naturally Plus Taiwan, Inc. of Taipei, Taiwan.

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Patient Consent: All patients mentioned in this contribution consented to use their clinical information via informed consent documents. All data collection and patient evaluations were approved by independent institutional review boards.

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