PACKETS OF HOPE:

A National Initiative of The Healthy Foundation

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INTRODUCTION

Guided by a vision of improving the health of those most in need, The Healthy Foundation was established in 1999 and is headquartered in Los Osos, California.

The Foundation's mission is "To provide at-risk populations with basic nutrients through supplementation".

It has three major goals:

1. To develop programs and collaborations providing dietary supplements for adults and children at-risk for nutritional deficiency.
2. To support educational and informational programs on the value of nutritional supplementation for at-health-risk populations.
3. To advance high quality research on the efficacy of nutritional supplementation for those at-risk for nutritional deficiency.

The Healthy Foundation recognizes that malnutrition contributes to and exacerbates acute and chronic illness. For thousands of poor, homeless and needy adults and children, a daily vitamin mineral supplement can make the difference between health and disease, between impaired brain function and school achievement, between violence and cooperation, between depression and the ability of each individual to realize their full potential. Good nutrition is fundamental to both physical and mental health.

The Healthy Foundation's ***PACKETS OF HOPE*** is a national initiative that provides a daily multivitamin for groups at risk for malnutrition and its consequences. At risk groups include children, pregnant women, teenage girls, poor and/or homeless, the elderly, and others. Working with faith based organizations, relief organizations, schools and school districts, foster care and youth homes, as well as agencies and organizations such as Health Care for the Homeless Clinician's Network, Second Harvest of America Food Banks, as well as other Foodbanks and Pantries, Girls Incorporated, Stand Up for Kids, Volunteers of America, the YMCA, Economic Opportunity Commissions, Community Action Agencies, Head Start Programs, The Healthy Foundation is positioned to provide over 5 million daily vitamin/mineral supplements (approximately 14,000 per day) to those in need in 2001 in the United States.

The *PACKETS OF HOPE* Programs

CHILDREN AT RISK- Poor, needy and homeless children miss essential nutrients every day and risk impaired brain function and immunity, stunted growth and behavioral disorders, denying them the opportunity to reach their fullest potential. This program offers a daily multivitamin to ensure their health and well being now and in the future.

VITAMINS FOR THE HOMELESS- Homeless men, women and children often suffer malnutrition due to poor food choices and lack of adequate food. A daily multivitamin can assure that they receive at least the minimum essential vitamins and minerals whether or not they find sufficient food that day.

OPERATON IQ- Without adequate nutrients, children have difficulty learning. Research shows a link between low levels of basic nutrients and poor academic performance. Nutrient deficiency is also linked with behavioral disorders, antisocial behavior and violence in our schools and in our communities. A daily multivitamin supplement can assure these children receive the nutrients they need for optimal school performance, health and well being. Working with visionary school districts, OPERATION IQ reaches out to support the minds of future leaders.

For less than 10 cents a day we have the opportunity to prevent illness and improve the health of those most in need. For every dollar spent on prevention, this country saves two dollars. IT JUST MAKES SENSE.

What does the Science Show?

- In 1.1 million school children, improved diet lead to a 16% improvement in academic performance, and the number of children labeled as learning disabled fell by almost one half
- In 8047 juvenile offenders, improved diet reduces violence and non-violent antisocial behavior by 48%, and improvements in conduct lasted at least one year.
- Greater amounts of essential nutrients-vitamins and minerals- are believed to correct impaired brain function due to poor nutrition
- Of 342 incarcerated adults and juveniles, the most violent offenders had the lowest intake of vitamins and minerals
- Violence is associated with low vitamin and mineral intake
- In 80 juvenile delinquents who received a daily multivitamin/mineral supplement for three months, antisocial behavior fell 43% and 37%
- 1753 children and young adults in California, Arizona, Oklahoma, Missouri, England, Wales, Scotland and Belgium, were studied. In every study, IQ rose 20% and the children gained an average of 16 IQ points.
- 300 school children in Arizona and California received supplements for three months. Those who took supplements improved academically at *Twice* the rate of those who did not.
- In 51,000 learning disabled children, after dietary revision, were no longer 2 or more grades behind.
- Benefits are found in those individuals who are deficient in at least one key nutrient
- 19 nutrients are involved in correcting conduct, academic performance, brain function, and intelligence
- The most common deficiencies in children whose conduct and performance improved after supplementation were found for: pyridoxine, pantothenic

acid, folic acid, thiamin, niacin and vitamin C. Deficiencies in vitamins A, E, riboflavin and B12 have also been linked to bad behavior. Nine minerals are linked to bad behavior- iron, calcium, copper, magnesium, zinc, selenium, manganese, chromium and molybdenum. Iron and magnesium are linked to low intelligence.

- Multivitamins slow the progression of HIV

We cannot afford to wait.

What do we mean by "Health"?

Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. (Healthy People 2000) In an ideal world, we, as a Nation should be capable of providing an opportunity for health, for all. The Healthy Foundation recognizes we do not live in an ideal world, but we also know that the provision of the most basic needs to our vulnerable populations is vital to the future of this country.

Packets of Hope is a coherent strategy to address the basic nutrient requirements that form the foundation for health. Extra effort is needed to assure that the most vulnerable groups are prepared to take charge of their health and the opportunities that await them. Our focus is on preventing some of the most costly problems that affect our communities. It is less costly, both economically and socially, to prevent the negative health consequences of malnutrition, than it is to deal with the painfully expensive aftermath.

The U.S. spends more per person on health care than any other nation, yet ranks 37th in the overall quality of care provided. (WHO 2000)

Who Is at Risk?

The Homeless, The Poor, The Elderly and our Children

Socioeconomic status is the number one predictor of poor health. (RWJF 2000) The poor are more than 3 times as likely to die prematurely or suffer disability from illness, despite nearly 2/3rds of the money for public health being directed to medical safety net services. (Lantz 1998).

In 1997, 13.3% or 14.6 million Americans lived in poverty. (U.S. Bureau of the Census, 1998a) 40% of them are children. The most recent, comprehensive study of homelessness by the Federal Government has estimated that that as many as 600,000 people are homeless on any given night (Interagency Council on the Homeless, 1994).

When we think of a homeless person, many of us immediately think of the "panhandlers" and "bag ladies" we've see on the streets of American cities; but only 20% of the homeless fit this stereotype. 44% are children and their families who cannot afford housing. 21% go to work and to school and they cannot afford to get sick. [See Table 1] They are predominantly African American males, but a significant proportion are children and families. [See Table 2]

By definition a homeless person is one "who lacks a fixed, regular, and adequate night-time residence and ... has a primary night time residence that is: (A) a supervised publicly or privately operated shelter designed to provide temporary living accommodations ... (B) an institution that provides a temporary residence for individuals intended to be institutionalized, or (C) a public or private place not designed for, or ordinarily used as, a regular sleeping accommodation for human beings"(National Coalition for the Homeless,1999c). This definition includes many of those currently without a permanent residence, especially those in the cities of America, but it does not address the homeless population in places where there are few if any shelters (such as rural areas and many smaller cities and towns), where homeless people tend to live with family or friends, often in overcrowded, substandard housing (U.S. Department of Agriculture,1996)

Families—including children living with one or both parents—and unaccompanied minors comprise a significant portion of the homeless population. Homelessness is an equal opportunity social problem, affecting all racial and ethnic groups. Episodes of homelessness can result from unemployment, illness, domestic abuse, natural disaster, and other circumstances. For some, this is a brief, one-time experience; for others, homelessness is a recurring part of their lives (McDonald, 1989).

Families with children are one of the fastest growing segments of the homeless population (National Coalition for the Homeless, 1999c). Precisely because the economic picture was generally favorable, rents had increased and landlords could afford to be more selective about prospective tenants. These trends make affordable housing nearly impossible to find for those with low-incomes, especially families (U.S. Conference of Mayors, 1999). In addition, many experts believe that families, single mothers, and children comprise the largest group of homeless people in rural areas (Vissing, 1996).

Despite the healthy state of today's economy and the lowest unemployment rate in a generation, homelessness continues to be a major problem in the United States. Just last year, an estimated 25 percent of all requests for emergency shelter—38 percent of requests by homeless families—were not met because local governments and local charitable organizations lacked adequate resources (U.S. Conference of Mayors, 1999).

Homeless children experience worse health; more developmental delays; more anxiety, depression and behavioral problems; and lower educational achievement. (Shinn and Weitzman, 1996)

It is estimated that almost half of these children are under the age of 5. (Homes for the Homeless, 1998) A 1998 study from the National Health and Nutrition Survey revealed that approximately 9-12 million Americans lived in families that reported sometimes or often not having enough food to eat. (NHANES III, 1998)

The malnourished elderly get more infections and diseases; their injuries take longer to heal; surgery is more risky; and hospital stays are longer and more expensive. Nutrition intervention is cost effective and results in fewer complications; faster recovery and shorter hospital stays; and reduced hospital expenditures. (AAFP 2000)

Besides age, gender and race, studies of the homeless population show that they share other characteristics as well.

- **Military service**: Studies show that a large number of homeless men are veterans. A recent study found that 14 percent of the homeless urban population were veterans (U.S. Conference of Mayors, 1999). Other studies have found that as many as 40 percent of homeless men have served in the armed forces (National Coalition for the Homeless,1999c; U.S. Conference of Mayors,1998; U.S. Conference of Mayors,1999).
- **Domestic abuse:** A recent study of 777 homeless parents in 10 American cities found that 22 percent had left their most recent homes because of violence committed by spouses or other household members (Ten Cities 1997-1998: A Snapshot of Family Homelessness Across America,1999).
- **Mental illness:** Approximately 19 percent of the homeless suffer from mental illness (U.S. Conference of Mayors, 1999). The vast majority do not require institutional care but could be productive members of society if they had appropriate housing and treatment (National Coalition for the Homeless, 1999b).
- **Addictions:** Although addiction is definitely a contributing factor to homelessness, the actual number of those suffering from addictive disorders is probably between 25 to 30 percent of the adult homeless population (National Coalition for the Homeless,1999b). Indeed, the 1999 U.S. Conference of Mayors survey revealed that 31 percent of the homeless population abuses drugs and alcohol.
- **Employment Status:** Although this fact may be surprising to many, 21 percent of the homeless are employed either full or part time (National Coalition for the Homeless, 1999b).
- **HIV Status:** Approximately 8 percent of the homeless population has AIDS or HIV-related illness. It is likely that the percentage of homeless people that are HIV-positive is considerably larger than in the general population as a result of poor nutrition, alcohol and substance abuse, mental illness, and failure to practice safe sex (U.S. Conference of Mayors,1998).

Experts agree that improved conditions could foster a healthier and less dependent generation, reducing pressures on schools, social welfare agencies and the health care system. But racial and economic disparities threaten to skew the benefits of a strong America in the 21st century.

What Are They At Risk For?

Common physical health problems seen frequently are hypertension, diabetes, peripheral vascular disease, respiratory problems, chronic liver and renal disease, infectious diseases, skin disorders, foot problems, anemia and life threatening

infections. (Brickner, 1990; O'Connell, 1991; Wlodarczyk, 1988; Braekey, 1989;Ferenchick, 1991) Some estimates suggest that fully 20% of homeless admissions to hospitals are preventable.

Poor socioeconomic status is associated with increased morbidity and mortality. The poor and homeless are at risk for increased severity and complexity of illness (NHANES III). Individuals deficient in the basic vitamins and minerals are more prone to infection and at higher risk for chronic diseases and cognitive dysfunction. Low income populations are at risk for insufficient intake of calcium, vitamin E, zinc, iron and phosphorus, magnesium and vitamin B6. (NHANES III) Although vitamin and mineral intake among Americans differ little across socioeconomic levels, the consequences of chronic deficiency cost more in the low income populations.

Hungry children cannot learn to their fullest potential. (Anand 1999) Malnourished children score lower on achievement tests. (Johnson 1999) Educational benefits will show the greatest improvement when improved environments are experienced from a younger age. (America's Children 2000) According to the U.S. Department of Agriculture, the diets of most children need substantial improvement to meet the dietary recommendations. Children with asthma should take a calcium supplement and multivitamin every day to prevent bone loss associated with the disease. (Spahn, 2000)

Bruce Ames of the University of California, Berkley, suggests that a lack of vitamins can damage a person's DNA, causing damage associated with cancer. (Ames 2000) He said," You can solve all these problems with a multivitamin."

The low-income elderly or those who are unable to care for themselves are especially vulnerable to malnutrition, due to food insufficiency. They have lower mean intake of key micronutrients including the B vitamins, iron, zinc, vitamin C and E, carotenoids and folic acid. This impairs immunity, cognitive function, cataracts, possibly cancer and heart disease, as well as chronic infection and disease. (NHANES III). Deficiency of folic acid has been linked to leukemia. B 12 deficiency is linked to mental illness and associated with damage to chromosomes. 85% of the elderly have one or more chronic conditions that have been documented to benefit from nutritional interventions. (U.S. Senate Report,2000)

WHY NUTRITIONAL SUPPLEMENTS?

There is virtually unanimous scientific agreement that dietary patterns and nutrient intake can profoundly affect overall health and substantially influence a person's risk of developing numerous chronic and degenerative diseases. (Frazao 2000)). Food provides vitamins, minerals, calories for energy and other biologically active components that support health and reduce the risk of chronic diseases. Inadequate food intake leads to hunger and malnutrition. Inadequate nutrient intake can lead to nutritional deficiencies, which create vulnerability to illness.

Experts agree that nutritional supplements can be of benefit to those who do not eat enough food, when the foods they eat do not provide the essential nutrients or when nutrients cannot be absorbed from foods due to those with certain diseases, the elderly and those with low energy intake. (LSRO 2000)

The diets of the homeless and poor are generally high in fats, carbohydrates and sugar and low in calcium, fiber, and essential nutrients. Often eating only one meal a day, containing high caloric value and low nutrient value, it is impossible to get the necessary nutrients to prevent deficiencies. Even in the typical American diet- 45% fat, 15% sugar and 15% white flour- 70% of our calories come from foods that contain few vitamins and minerals. Calories are essential to life, but when calories fall below 1700 a day for men, or 1200 a day for women, the liver uses vitamins as fuel rather than as vitamins, thereby producing vitamin deficiency.

Although emphasis should continue to stress a balanced diet that incorporates a variety of foods, when a lack of adequate food or poor food choices create even low levels of essential nutrients, the risk of disease or complications from illness become an important issue.

A large and expanding body of research suggests that dietary supplementation offers the potential benefit of improved immunity and resistance to disease, decreased incidence of illness, less severe illness and better cognitive performance. The Recommended Daily Allowances set by the USDA are standards for the minimum adequate amounts of vitamins and minerals necessary to prevent deficiencies and meet nutritional needs of healthy people. The newer Dietary Reference Intake values from the Food and Nutrition Board recognize the need to increase intake to promote health and prevent disease.

Nutritional supplements may even provide a benefit to those with an adequate diet (Dickenson, 1998). And, in fact, most Americans do not eat as well as they should, despite the availability of health promoting foods. (Frazao, 1998) Further, it is recognized that even adequate nutrient intake may not be sufficient to minimize the risks for chronic diseases. Thus, we, as a Nation, need to rethink our nutrition policy. However, for the malnourished, poor and homeless, we cannot wait.

Poor diets and eating habits have been estimated to cost this country $71 billion dollars a year in premature deaths and medical care costs (Frasao, 1998). Diet is a significant risk factor for heart disease, cancer, diabetes, hypertension and obesity. Unacceptable costs result from poor health and the added care it requires. Minor problems develop into health care emergencies and treatment becomes more expensive, delivered through hospital emergency rooms and acute care wards.

It is estimated that fully 1/3 to ½ of homeless adults have some physical illness and at least ½ of homeless children have a physical illness. This lack of health prevents

many from leaving homelessness. (Burt, 1989) The homeless are more than twice as likely to suffer from health care problems than those with stable housing (Health Care for the Homeless Information Resource Center, 2000). These health problems include anemia, diarrhea, dehydration, physical growth and brain development problems in children, tuberculosis, hepatitis, HIV/AIDS, diabetes, hypertension, and many others (Bronner, 1996; National Coalition for the Homeless,1999a). Many of these illnesses and physical conditions are caused by poor nutrition; others are exacerbated by it.

Efforts to improve diet could markedly decrease morbidity and mortality associated with both acute and chronic illness. This would result in lower health care costs, lower institutional costs, less lost productivity, and improved quality of life.

In fact, the cost of chronic illnesses is estimated to reach $1.07 Trillion by 2020. Almost ½ of all Americans have a chronic illness, complicating care and making it more expensive. Chronic illness may not kill someone, but may require a lifetime of medication and doctor visits. Preventive care can stave off many chronic illnesses. Total annual cost for someone with chronic illness is by some estimates, three times higher than for a healthy person- $3,074 vs. $817. (Hoffman, 1996)

Most physicians and dieticians agree that vitamins and minerals should come from the foods you eat. But, they also recognize that dietary supplements are useful when dietary selection is inadequate, due to lack of access or poor food choices. (American Dietetic Association, 1995; U.S. Conference of Mayors,1998). The American Medical Association specifically recognizes the homeless as a group "particularly at risk" for vitamin and mineral deficiencies (American Medical Association, 1999; U.S. Conference of Mayors,1998).

Those at risk for nutritional deficiencies include those without access to adequate food, poor diets and those who suffer other medical conditions that raise nutrient needs. Usual intake of nutrients below 100% of the RDAs is more common among low income people. (Guthrie, 1998). In vulnerable groups, like the low income elderly and women of child bearing age, dietary intake of some key nutrients is a below recommended levels. (Guthrie, 1998). The AMA also recognizes these groups to be at risk, along with teens, low income children and others in poverty.

A 1990 survey by professional dieticians of the nutritional adequacy of the diets of some homeless people and the quality of shelter meals showed that while 90 percent of those surveyed reported that they obtained enough to eat, the quality of their diets was seriously inadequate (Luder, Ceysens-Okada, Koren-Roth, & Martinez-Weber,1990b).

Homeless women and children typically consume less than half the RDA of iron, zinc, magnesium and folic acid each day. The diets of homeless men are typically low in calcium, zinc, B-6, and overall calories. These poor diets, lacking essential vitamins and minerals, put homeless people at risk of illness and chronic

conditions. Pregnant women, children, and those with compromised health are especially vulnerable (McNally, Kruse, Seiber, & Soechting, 1997).

The elderly risk cataracts, cognitive decline, osteoporosis, B12 deficiency and more.

These at risk populations will benefit from dietary supplementation. It just makes sense. We have tried to eradicate hunger and failed. We cannot assure adequate food intake, but we can assure adequate essential nutrient intake. Dietary supplementation will never take the place of food, so necessary for energy. But dietary supplementation can improve health status, quality of life and the utilization of scarce resources.

Supplementation and the Homeless

Homeless men and women are both physically and socially disadvantaged. Their nutritional status is also often compromised. In one sample of 107 homeless men, about half reported taking vitamin supplements (with varying duration and regularity), usually a regimen consisting of thiamin, vitamin C, folic acid and a multivitamin-B-complex capsule. Little clinical effect was observed. However, biochemical measurements showed significant differences. The numbers of men classified as deficient were higher by about 20 per cent for those reporting not taking vitamins. The mean biochemical levels were significantly better for the supplemented group for thiamin, as assessed by TPP per cent effect ($P = 0.04$), vitamin B6, as assessed by P5'P per cent effect ($P = 0.002$), vitamin C ($P < 0.001$) and blood folate ($P < 0.02$).

Therefore, on the basis of the mean biochemical levels of vitamin status seen in this study, the supplemented group was better off then the group not taking supplements. This demonstrates that supplementation is effective in changing vitamin status in the homeless, and it is reasonable to presume that in the long term this would be reflected in improved clinical status. (Darnton-Hill, Sriskandarajah, Stewart, Craig, & Truswell,1993)

Supplementation and Education, IQ and School Performance

Children are especially vulnerable to malnutrition (Rafferty & Shinn, 1991; Drake,1992; Rafferty & Shinn,1991; Wood, Valdez, Hayashi, & Shen,1990; Shulsinger,1990). Studies in the areas of nutrition, IQ, and academic performance have shown that subjects who improve with nutritional supplementation are those who were malnourished initially while those with sufficient nutrition are unaffected (Schoenthaler & Bier,1999a; Schoenthaler, Bier, O'Brien, Young, & Jansenns,1999; Schoenthaler & Bier,1999b; Schoenthaler & Bier,1999b).

Vitamin supplementation can improve IQ in School age Children (Schoenthaler 2000). 254 school-aged children were studied to determine the effects of a multivitamin on intelligence. Half received a 50% of RDA formula daily multivitamin for three months. The supplemented group showed a gain of 9.97 points in IQ. 44% gained more than 15 points. The presumption is that only a minority of children may have less than optimal diets and they show the most

improvement. This powerful observation, the ability to raise IQ with a daily multivitamin supplement suggests nutritional supplementation should be made available to students with poor academic performance.

Supplementation and Mental Health and Behavior

Although much research remains to be done on the connections between diet and behavior, the available evidence points to a significant causal relationship between deficiencies of vitamins and minerals and behavioral problems ranging from inattention and hyperactivity, to depression, aggression and even attempted suicide. It seems clear that vitamin supplementation will have a positive effect on behavioral problems in at risk populations.

There is a significant body of literature exploring the association between diet and behavior. This literatures indicates that for a portion of the population, diet may be associated with or exacerbate conditions such as learning disability, poor impulse control, intellectual deficit, a violent tendency, hyperactivity, and substance abuse.

Supplementation and Criminal Justice

Malnutrition contributes to learning disabilities, poor impulse control, violence and associated behaviors, and academic failure. All these behaviors are recognized as precursors to criminal delinquent behavior (Fishbein & Pease, 1994). Violent offenders tend to be persistent or frequent offenders. Studies have also demonstrated that compared to the general population, violent individuals possess a greater preponderance of decreased levels of certain vitamins or minerals (Pihl & Ervin,1990; Schauss et al.,1979; Cromwell et al.,1989; Walsh et al.,1997; Schrauzer et al.,1992; Gray et al.,1993; Mufti, Balon, & Arfken,1998; Pihl & Ervin,1990; Schauss et al.,1979). (Gans, 1991; Cromwell, Abadie, Stephens, & Kyler, 1989; Gray,1986; Walsh, Isaacson, Rehman, & Hall,1997; Fishbein & Pease,1994; Waksman,1983; Rimland,1983; Mattes,1983; Kavale & Forness,1983; Adams,1981; Rogers & Hughes,1981; Holborow, Elkins, & Berry,1981; Baker,1980; Crook,1980; Williams & Cram,1978; Rapp,1978; NIH Consensus Development Conference: Defined diets and childhood hyperactivity.,1982; Mattes & Gittelman,1981; Chernick,1980; Schrauzer, Shrestha, & Flores-Arce,1992; Chernick,1980; Pihl & Ervin,1990; Schauss, Bland, & Simonsen,1979; D'Asaro, Groesbeck, & Nigro,1975; Schoenthaler,1983c; Schoenthaler,1983b; Schoenthaler,1983a; Schoenthaler,1983c; Schoenthaler & Doraz,1983; Schoenthaler,1983b; Schoenthaler,1982; Schoenthaler,1983a).

Studies exploring the correlation between dietary intake and behavior have investigated the effect of vitamin-mineral supplementation (D'Asaro et al., 1975), cholesterol intake and blood levels or whole dietary changes on behavior. (Schoenthaler, 1983c; Schoenthaler, 1983b; Schoenthaler, 1983a; Schoenthaler, 1983c; Schoenthaler & Doraz, 1983; Schoenthaler, 1983b; Schoenthaler, 1982; Schoenthaler,1983a; Fishbein & Pease,1994; Talington & Riley,1971)

One trial by Schoenthaler (1987) examined the regular, non-modified diet of institutionalized criminals and assessed correlations between dietary intake of specific nutrients, and antisocial behavior. Malnourished inmates, defined as consuming less then 70 percent of the RDA in five or more nutrients, were significantly more likely to exhibit antisocial behavior ($p = .001$). Weak negative

correlations also were found between 14 nutrients and various antisocial behaviors.

These studies strongly suggest that micronutrient supplementation can markedly reduce violence and antisocial behavior in juveniles.

Typical school children in two primarily Hispanic public elementary schools were surveyed. 80 had been disciplined at least once in the previous 9 months. Violations included rules infractions, fighting, and destruction of property, defiance, disorderliness, and endangering others. Over a 4-month period, half were given a multivitamin/mineral supplement, at 50% of the RDA. The mean violations per student were 47% lower in the supplemented group. In the habitually disruptive group, the improvement was most obvious. This suggests that impaired brain function due to malnutrition caused an inability to learn from discipline. For children who manifest disciplinary problems, in and out of school, we may have an inexpensive means to avoid violence and aggression in our schools. (Schoenthaler 2000)

Prison Inmates

Trials of dietary manipulation and behavior in imprisoned male offender populations have demonstrated decreases in overall behavioral infractions ranging from 21 percent–55 percent (D'Asaro et al., 1975; Schoenthaler, 1982; Schoenthaler, 1983b; Schoenthaler & Doraz, 1983; Schoenthaler, 1983a; Schoenthaler, 1983a; Schoenthaler, 1983b; Schoenthaler, 1983c; Schoenthaler, 1983c), with some trials showing reductions in violent behaviors such as assault at 82 percent (Schoenthaler & Doraz,1983). Since a large section of the homeless population is male, and both populations are known to be at risk for malnutrition, it is conceivable that a similar reduction in behavior problems would be seen in homeless populations. The epidemiology of juvenile violence strongly suggests that vitamin and mineral deficiencies play a key role.

The average cost, in 1989 the most recent data, in this country to incarcerate someone for one year was $18 217 (McDonald, 1989). If we assume decreases in behavioral problems at 20 percent, the lowest of any of the studies, with an estimated 2.3 million people homeless during any given year (Interagency Council on the Homeless, 1994), it is clear that there would be a substantial economic impact by making supplementation available.

The cost of juvenile violence was recently measured in Pennsylvania. The resulting study reported that costs of juvenile violence, in that single state, were largely due to the costs to care for the victims of juvenile violence. Juvenile violence accounted for $5.4 Billion in victim costs. The total criminal justice costs spent for juvenile offenders was over $46 million. The long term risk factors for juvenile violence are impulsivity, low intelligence, poor academic performance, poverty, and biologic factors. These authors concluded that violence is a major public health threat and the source of significant public expenditures for both juvenile victims and perpetrators. They suggest there is an urgent need to redirect resources to focus on prevention programs. (Miller 2001)

It is imperative that this country begins to formulate policies that allocate scarce resources to preventing juvenile violence. We know that violent children turn into violent adults. We also know that a simple solution that addresses the nutritional component of violence can result in significant reduction in the numbers of offenses and the repeat and escalating numbers of criminal behaviors among our youth as well as our adult populations.

MALNUTRITION AND DISEASE

There is considerable evidence in research by physicians, professional dieticians, and social scientists that poor nutrition results in a wide range of medical, developmental, and emotional problems, and that vitamin supplementation can prevent or significantly remediate these problems.

The new U.S. Recommended Dietary Allowances (USRDAs), released in 1997, 1998, 1999 and 2000, were set to prevent chronic illness, and prevent nutrient deficiencies, based on the current scientific knowledge. People who eat less than the RDAs are at nutritional risk. The RDAs represent the daily dietary intake levels sufficient to meet the nutritional needs of 97-98% of all healthy individuals in a group. However, the homeless and poor are not healthy as a group and inadequate dietary quality has been documented in this group. (Luder, Boey, Buchalter, & Martinez-Weber, 1989; Luder, Ceysens-Okada, Koren-Roth, & Martinez-Weber, 1990a; Shulsinger, 1990; Darnton-Hill & Truswell, 1990; Wiecha, Dwyer, & Dunn-Strohecker, 1991), with decreased status of certain nutrients (Darnton-Hill & Truswell,1990; Skelton & Skelton,1990).

Many diseases have been linked to nutrient deficient diets; however, reviewing these associations is beyond the scope of this paper. The latest figures from the Centers for Disease Control (Hoyert, Kochanek, & Murphy, 1999) indicate that fully 54 percent of deaths in this country are related to one of two causes – heart disease or cancer. Both of these diseases have strong associations with nutrient deficiencies. Examples of selected associations are presented below.

Heart Disease-Vitamin C supplementation protects against coronary heart disease. Supplementation has been shown to lower plasma total cholesterol and, among some elderly men, to raise high-density lipoprotein cholesterol. However, among people in initially good vitamin C nutrition, these effects are usually not seen, demonstrating the need for vitamin C supplementation in populations with poor nutrition, such as the homeless (Boushey 1995; Plotnick 1997). One placebo-controlled, double-blinded study revealed that extra ascorbic acid taken for six weeks was observed to lower systolic and pulse pressure in a small group of borderline hypertensive subjects (Trout, 1991).

Antioxidants, folic acid and other B vitamins may reduce the risk of heart disease. A recent meta-analysis revealed that 56,000 deaths due to heart disease could be prevented with adequate folic acid intake alone. (Boushey 1995) Epidemiological studies consistently reveal an increased risk of Ischemic heart

disease and stroke at low plasma concentrations of antioxidants, with the rank order of vitamin E, vitamin C then vitamin A. (Gey et al., 1993). Over a 10-year follow-up period, individuals reporting high intakes of vitamin C exhibit significantly lower risk of death from all causes, particularly from coronary heart disease, (Tribble, 1999).

Ecologic studies of vitamin E have shown that regions with relatively low dietary vitamin E tend to have higher rates of coronary heart disease (CHD) (Stampfer & Rimm, 1995). Laboratory studies have shown vitamin E to have several potentially cardioprotective effects.(Spencer, Carson, & Crouch, 1999). Several prospective studies, including the U.S. Nurses' Health Study and the U.S. Health Professionals' Follow-up Study, found a 34 percent and 39 percent reduction, respectively, in the risk of having a cardiac event for those taking vitamin E supplements. The Iowa Women's Health Study found a 47 percent reduction in cardiac mortality. The Cambridge Heart Antioxidant Study, found a 47 percent reduction in fatal and nonfatal myocardial infarction in patients with proven coronary atherosclerosis that were given 400 or 800 IU of vitamin E daily (Emmert & Kirchner, 1999). Two large prospective studies found that persons who had used vitamin E supplements for at least two years had approximately 40 percent lower rates of Coronary Heart Disease (Stampfer & Rimm, 1995).

Recent evidence has shown that homocysteine is a risk factor for cardiovascular disease and may be one of the missing links in explaining the persistently high mortality associated with cardiovascular disease (Reeder, Hoffmann, Magdic, & Rodgers,2000) (Seshadri & Robinson,2000). Low folic acid intake is an important determinant of elevated blood levels of homocysteine. (Verhoef, Stampfer, & Rimm,1998; Mayer et al.,1996).

Cancer- Epidemiologic evidence of a protective effect of vitamin C for non-hormone-dependent cancers is strong (Chan & Reade, 1998). Of 46 studies, 33 found statistically significant protection, with high intake of vitamin C conferring approximately a twofold protective effect compared with low intake. Of 29 additional studies that assessed fruit intake, 21 found significant protection. For cancers of the esophagus, larynx, oral cavity, and pancreas, evidence for a protective effect of vitamin C or some component in fruit is strong and consistent. For cancers of the stomach, rectum, breast, and cervix there is also strong evidence. Several recent lung cancer studies found significant protective effects of vitamin C or of foods that are better sources of vitamin C than of beta-carotene (Block, 1991). Numerous epidemiological studies have pointed to the importance of dietary and supplemental ascorbate in the prevention of various types of cancer including bladder, breast, cervical, colorectal, esophageal, lung, pancreatic, prostate, salivary gland, stomach, leukemia, and non-Hodgkin's lymphoma (Head, 1998). Vitamin C supplementation has been reported to inhibit skin, nerve, lung and kidney carcinogenesis.

Antioxidants found in fruits and vegetables have been shown to reduce the risk of several types of cancer. Recent evidence suggests the protective effect of specific nutrients and cancer. High intake of Vitamins A, C and E have been

observed to reduce the risk of lung cancer (Yong, 1997); Vitamin C is protective against breast cancer (Howe, 1990); the use of multivitamins and vitamin E intake are associated with a reduced risk of colon cancer (White, 1997); and, adequate selenium intake has been linked to lower incidence of cancer of the lung, colon, and prostate. (Clark, 1997)

Diabetes- Diabetes contributes an additional 100,000 deaths each year. Diabetes leads to end-stage renal disease; heart disease; stroke and hypertension; blindness and lower limb amputation. The incidence of diabetes is higher among blacks and Hispanics, a large percentage of the homeless and poor. It is a significant cause of disability among the poor and malnourished. The role of vitamin supplementation in diabetes is still under investigation, though we know that it can be controlled with diet. Recent studies suggest that Chromium helps maintain healthy blood sugar levels and may be useful in diabetics, for disease maintenance.

Diet plays a role in hypertension, osteoporosis, and resistance to infection, morbidity and mortality.

Osteoporosis- It is estimated that the direct medical costs of osteoporosis will add $5-10 Billion dollars to costs of illness associated with poor diets. Calcium, Vitamin D and Vitamin K protect against this silent killer. Bone loss leads to fracture and hospitalization.
It has been estimated that adequate intake of calcium and Vitamin D in the elderly could reduce the rate of hip fracture by up to 20%, which translates to an average annual savings of $1.5-2 Billion. (Heaney 1993)

Cataracts- There is good evidence that antioxidants Vitamin C and E, and betacarotene could delay or prevent cataracts. (Taylor 1992; Seddon 1994; Jacques 1997) Lutein and zeaxanthin may reduce the risk of macular degeneration. (Landrum 1997)

HIV- multivitamin supplementation has been demonstrated to improve immunity and reduce rate of transmission. For infectious diseases in general, adequate intake of vitamins and minerals can reduce the vulnerability to infection and chronic illness. (Chandra 1992; Bogden 1994; Meydani 1997).

The adverse health effects of poor diet are numerous and cumulative and not likely to manifest early. The costs of diet's influence on disease are considerable. Health care spending in the U.S. was $1 Trillion dollars, or 13% of the GDP. The potential for huge savings in health care costs from improved diets merits closer attention (Frazao 2000).

It is always more expensive to treat disease AFTER it occurs than to prevent it.
The use of multivitamins could have diverse benefits. It could virtually eliminate the risk of micronutrient deficiencies in the poor and provide substantial assurance against anemia in children and women of childbearing age; and folic

acid can prevent neural tube defects. It would also prevent nutrient deficiency in the elderly and improve immune function. (Dickinson, 1999)

A year's supply of micronutrient supplementation costs less than one doctor's visit and much less than hospitalization for only one day. The data suggest that a multivitamin is a cost effective prevention intervention. (Chandra 1999).

Effect of Malnutrition on Pregnant Homeless Women and their Unborn Babies

The development of the unborn baby is profoundly influenced by maternal nutrition (Wahid & Fathi, 1987). Homeless and poor pregnant women are at risk for a variety of illnesses that could affect their pregnancies. Poor access to prenatal care, inadequate prenatal care, poor nutrition, and poor housing result in poor birth outcomes. They are more likely to deliver low birth weight infants and have higher rates of infant mortality (Beal & Redlener, 1995).

Research has shown that a child's health in later life may, in part, be determined by his mother's nutrient intake during pregnancy. (Hautvast, 1997). Increasing evidence suggests that even marginal deficiencies in women may have deleterious effects on pregnancy outcome. Nutrition interventions have demonstrated beneficial effects directed at high-risk women, such as homeless women. (Pickard, 1986).

The consequences of poor maternal nutrition range from spontaneous abortion and stillbirth to congenital malformations. Limited maternal weight gain and subsequent low birth weight are the most common result of sub optimal maternal nutrition (Worthington-Roberts, 1985).

About 80 per cent of perinatal deaths are associated with low birth weight. A mothers' prepregnancy weight is correlated with birth weight. (Wynn & Wynn, 1988).

For most healthy women, the only nutritional intervention required may be adequate iron and folate intake; however, for others, who begin pregnancy in a malnourished state or whose nutritional intake deteriorates during pregnancy, invasive nutritional support, including tube feeding or parenteral nutrition, at high cost, may be indicated (Hamaoui & Hamaoui,1998).

Recent studies suggest that heart disease and stroke have their origins in the womb and are due to maternal diet. It is thought these diseases are the consequence of early nutrient deficiencies that result in long-term changes in physiology or metabolism. There are critical windows of time during which maturation must be achieved. If this maturation is inhibited by lack of the necessary nutrients, the failure of maturation is largely irrecoverable (Barker & Clark, 1997). For example, the normal vitamin K status of the human embryo appears to be close to deficiency. Maternal dietary deficiency may result in frank vitamin K deficiency in the embryo, which in the first trimester results in facial and orthodontic abnormalities (Howe & Webster, 1994).

B vitamin deficiency, especially of folates, in the preconceptional period has been definitively associated with neural tube defects. Available evidence confirms the significant impact of preconceptional nutrition on pregnancy outcome (Vobecky, 1986). Nearly all nutrients are required in increased amounts during gestation but the magnitude of the increase varies from nutrient to nutrient. Folate requirements are doubled during pregnancy and gestational needs for iron cannot be met by diet, therefore, supplementation should be provided (Pitkin, 1977). When supplemented before conception, iodine prevents cretinism (Keen & Zidenberg-Cherr, 1994), a result of hypothyroidism during fetal development.

Zinc is essential for normal growth and zinc proteins have been shown to be involved in the transcription and translation of the genetic material. Zinc deficiency has been incriminated in infertility, abortion, malformations, fetal intrauterine growth retardation, premature and postmature births, perinatal death, and abnormal deliveries. Those with insufficient food intake are at risk for zinc deficiency. Zinc therapy in identified low-zinc groups has given favorable results and has reduced the frequencies of premature birth, placental ablation, perinatal death, and postmaturity. (Jameson, 1993).

Magnesium supplementation during pregnancy has a positive effect, with reduced incidence of hospital admission and preterm labor, while improving fetal development.

Late in gestation, adequate maternal vitamin A status is important for newborn reserves and for sustaining adequate breast-milk concentrations. Vitamin A supplements are not needed for most pregnant women in Western countries who consume the recommended dietary allowance during their reproductive years. However, women whose habitual intakes are near basal should receive an additional 100 micrograms retinol equivalents (RE) during pregnancy and 300 micrograms RE during lactation (Underwood, 1994).

Recent research suggests that a multivitamin can raise immune status in HIV positive mothers. This is a low cost way to reduce the risk of adverse pregnancy outcomes including fetal death, growth retardation and preterm birth, all of which are associated with the immune status of the fetus. It is hypothesized that poor fetal immunity promotes transmission of the AIDS virus to the fetus. Thus, it is thought that improved maternal immunity leads to greater fetal immunity and lower risks of infection, including infection with the AIDS virus, as well as malnutrition and death of the fetus.

Potential supplementation benefits include 1) improved nutritional status, 2) reduced risk of some developmental defects, 3) improved antioxidant and immune defense systems, and 4) lower incidence and/or slower progression of some diseases. (Keen & Zidenberg-Cherr, 1994).

Effects on Children

Every parent knows that a chronically poor diet will jeopardize his or her child's health in the present and in the future. Research shows that about 50% of children are missing sufficient amounts of Vitamins B6, A, calcium, iron and zinc. This leads to increased risk for infection, illness and complications from minor illness. Deficiencies of the B vitamins can lead to depression, lack of coordination, and poor mental acuity. Vitamin and mineral deficiencies lead to stunted growth.

Over the past decade, Rickets, vitamin D deficiency has profoundly increased, a three-fold increase. Vitamin D deficiency often accompanies Calcium deficiency. Rickets are weak bones due to the inability to absorb Vitamin D. If left untreated, it can cause severe health problems including seizures. African Americans are particularly susceptible. This disease is 100% preventable.

Poor nutrition causes anemia, growth and development problems in children and exacerbates medical problems in adults. (Wiecha, et al, 1991)

THE ECONOMIC COSTS OF MALNUTRITION

Utilization and Costs of Health Care for the Homeless and Poor

Use of Emergency Services

Those who live in poverty cost more to treat. The lack of access to primary care combined with increased frequency and severity of illness result in increased utilization of scare resources. For many reasons, there exists little data on the cost of health care for at risk populations. But, a growing body of literature suggests that we cannot afford to wait to take action to improve the health of all Americans.

Homeless people more often .....use the emergency departments as a substitute for primary health-care. (Lewis, 1996). In a six-month period 135 homeless patients visited an emergency department 233 times. 82% of these visits were for minor problems, however 65 percent of patients had co-existing medical problems. (Little & Watson, 1996). On average, the homeless seek ER care 2.5 times a year, compared to 1.6 visits for the general population. (Braun)

Homeless people suffer from an array of problems that drive them to the ER including health and mental health problems, victimization and injuries. (Padgett, Struening, Andrews, & Pittman, 1995). However, the treatment of physical health problems accounts for the majority of use (Padget 1987)(Black et al., 1991)(Victor, Connelly, Roderick, & Cohen,1989). (Earnshaw, Barnes, & Brown, 1996).

Homeless children are at risk for more health problems and service use than housed children. They experience a higher number of acute symptoms, including fever, ear infection, diarrhea, and asthma. Homeless children are almost three times more likely to experience fair or poor health status, a 1.7 times higher frequency of outpatient visits and 1.2 times increased emergency department

visits (Weinreb, Goldberg, Bassuk, & Perloff,1998). In another study, over a one-year period homeless children presenting to the emergency room were more likely to be only mildly ill (33/70) than those from permanent housing (21/70). However, three of the 70 homeless children died of overwhelming infections compared with none of the controls (Lissauer, Richman, Tempia, Jenkins, & Taylor, 1993), indicating probable decreased immunity secondary to chronic malnutrition.

Service costs at a trauma center have been estimated at a mean total cost per patient of $22,618, with $7,998 being direct patient care without hospital overhead (Taheri, Butz, Griffes, Morlock, & Greenfield,2000). In the above-mentioned six-month study (Padgett et al., 1995) 18 percent of 233 emergency department visits by homeless people were for non-minor problems. This can be used as an estimate of 83 visits over one year at that one hospital. At a cost of $22,618 per visit, the possible cost at that single hospital per year could amount to almost $1.9 million dollars. Although this is an inflated figure for an emergency room admission compared to a trauma center, a figure of even 10 percent of that per admission, when multiplied over the number of hospitals in this country comes to an astronomical sum. For example, according to the Joint Commission on Accreditation of Healthcare Organizations, there are 4751 hospitals in this country. If we only examine the example of the three homeless children who died in one hospital from overwhelming infections compared to zero for children with homes, the costs in human and economic terms are staggering.

More frequent visits to the ER and more acute care hospital admissions suggest the profound costs of treating at risk populations after they get sick.

In North America, a year's supply of micronutrient supplementation costs less than 3 visits to a physician and much less than hospitalization for 1 day (Chandra 1997a). If even one day of hospitalization per year could be reduced, the cost of providing supplements to homeless people would be paid.

Hospital Admissions

In New York, the homeless are more often admitted to the hospital for the treatment of substance abuse or mental illness- 52% vs. other low income patients, 23%. Homeless patients stayed 4.1 days longer, 36% longer per admission on average than the other patients, even after adjustments are made for differences in the rates of substance abuse and mental illness and other clinical and demographic characteristics. The costs of the additional days per discharge averaged $4,094 for psychiatric patients, $3,370 for patients with AIDS, and $2,414 for all types of patients. (Salit, Kuhn, Hartz, Vu, & Mosso, 1998). In Boston, the hospitalization rate for homeless individuals was 2.7 times greater than the general population. (O'Connell, 1998) Length of stay for the lowest socioeconomic groups is 3-30% greater, and hospital charges for this excess account for 1-18% higher costs. In Hawaii, the total costs for admissions of homeless individuals was almost $4million: acute care cost $3.3 million; hospital care-$690,000. The authors estimated that the expense for the "excess" hospitalization was $3.5 million.

Veterans
A recent survey of Veterans Affairs medical centers found that homeless veterans were 7 times more likely to be hospitalized than other low income veterans. The average annual cost of care for homeless veterans, after adjusting for other factors, was $27,206; $3,196 (13.3 percent) higher than the cost of care for domiciled veterans ($P < 0.0001$). Approximately 26 % of all VA healthcare expenditures ($404 million) are spent on the care of homeless persons (Rosenheck & Seibyl, 1998).

Thus, it appears that homeless children have greater severity and frequency of illness and less access to primary care. Homeless adults were hospitalized 2-6 times more often than the general population in 5 major cities and states. Hospitalized homeless individuals account for thousands of dollars in longer stays. The homeless use ER services more frequently. The implications from these studies are profound. We cannot afford to ignore the potential benefits of prevention and vitamin supplementation.

POTENTIAL COST SAVINGS OF VITAMIN AND MINERAL SUPPLEMENTATION

Impact on Children
IF just a few children avoided academic failure and became productive members of society, the economic impact would be difficult to measure in dollars but would be priceless to society. If just a few children could avoid the stigma of being labeled with a learning disability, society would be enriched.

If just a few children avoided infection and disease, the impact would be immeasurable.

Impact on Birth Defects and Low Birth Weight Babies
Homeless women typically consume less than half the RDA of both folic acid and zinc each day (McNally Kruse, Seiber, & Soechting, 1997). Both of these nutrients have been shown to be crucial in ensuring a healthy birth.

It is commonly accepted that folic acid is necessary to prevent the occurrence of neural tube birth defects. In fact, the FDA recommends that all women of childbearing age take a folic acid supplement. If all women of childbearing age used multivitamins with folic acid, it is estimated that it may be possible to reduce the current incidence of neural tube birth defects by 50% or more. (MMWR 1992) Nationwide, there were 4600 babies born in 1992 with a primary diagnosis of neural tube defects, representing hospital costs of $141 million (Bendich 1997) and total costs of $489 million, or $294 000 per new case (CDC. Economic costs of birth defects and cerebral palsy -United States, 1992).

Thirty seven percent of the homeless population described in the U.S. Conference of Mayors 1999 survey (U.S. Conference of Mayors, 1999) consisted of children (21 percent) and one or both of their parents (16 percent). If we assume that 10% of the homeless population are women of childbearing age,

we have an estimate of 276 000 women of child-bearing age homeless in any given year. If even 10 cases of spina bifida are prevented through supplementation, there is a potential saving of almost $ 3 million dollars.

The trace mineral zinc is important in growth of the fetus, and zinc deficiency has been implicated in low birth weight babies. If pregnant women used a multivitamin containing zinc, it should be possible to substantially reduce the number of babies born with low birth weight. Currently, about 280,000 low birth weight babies are born each year, for an annual cost of $2.6 billion (Bendich 1997), or almost $10 000 per low birth weight baby. As compared to the general population, which has a rate of low birth weight babies of 7%, homeless women have been shown to have a low birth weight rate of up to 25%(National Center for Health Statistics, 1996 final natality data;(Parsons 1991). It is probable that supplementation could reduce that rate to the national average.

Impact on the Elderly, Osteoporosis and Cost of Hip Fractures

Among the elderly, the routine use of a multivitamin and mineral supplement could improve immune function and thus reduce infectious disease (Chandra 1992). Supplementation with calcium and vitamin D could reduce the rate of hip fracture by up to 20%, meaning 40,000 to 50,000 fewer hip fractures every year in the United States, for an average annual savings of $1.5 to $2 billion (Heaney 1993). Assuming the 1% figure for homeless people, an annual savings of $15 to 20 million dollars is possible.

Impact on the Cost of Cataracts

Regular use of antioxidant vitamin supplements including vitamin C and vitamin E could delay the onset of cataracts by 10 years, thereby reducing the need for cataract operations by half. This would save a large proportion of the $3.5 billion spent annually for such operations (Taylor 1992). At the 1% figure, a substantial proportion of $35 million could be saved. Protein, vitamin A, niacin, thiamin and riboflavin protect against cataracts. (Cumming, 2000)

Impact on Heart Disease

Studies listed above have shown an average of 40% reduction in heart disease from supplementation including vitamin E and vitamin C. Long-term vitamin E supplementation has the potential to reduce the incidence of and mortality from heart disease. Studies suggest that up to $8.4 billion could be saved if people took at least 100 IU per day of vitamin E on a regular, long-term basis (Bendich 1997). Again, at the 1% level, $84 million could be saved.

Summary

The examples above demonstrate that providing vitamin supplementation for the homeless and other at risk populations is smart economic policy. Using only the examples we mentioned above, we have the potential savings of:

Health Issue	**Potential per year saving**
Increased cost of hospitalization	$750 000
VA mental health expenditures	$4 million
10 cases of spina bifida	$ 3 million
Hip fractures	$15 million
Cataracts	$35 million
Heart disease	$84 million
TOTAL	**$141 750 000**

The Bottom Line

Malnutrition is costing America immeasurable dollars and lost opportunities. It contributes to poor learning, stunted growth and developmental delay. It impacts mental and physical illness, and increases the incidence of many antisocial and violent behaviors.

Daily vitamin and mineral supplementation can make the difference in our schools and communities; in our prisons and hospitals. For pennies a day, we intend to give every American the chance at health and productivity.

THE PROGRAM

The ***PACKETS OF HOPE*** initiative is intended to address the inadequate nutrition of poor and homeless individuals by supplying them with daily vitamin and mineral supplements.

- Children will receive chewable multi-vitamins.
- Pregnant women and nursing mothers will receive a daily prenatal formula.
- Adult men and women will receive a US-RDI level formula that takes into account, the special needs of this population.
- All supplements will contain at least the daily minimum essential vitamins and minerals as established by the Recommended Daily Intake and in some cases, will provide select nutrients at the Upper Tolerable Limit, the highest amount of a nutrient that can be safely consumed on a daily basis.
- When funded, the Program will include nutritional assessment.

How Much Will This Program Cost?

The *PACKET OF HOPE* project has been planned for implementation in five phases.

The results of the recently completed first phase, the Vitamins for the Homeless project, suggest that it will have exactly the outcome desired.

This 60-day pilot project in Los Osos, CA was completed in March 2000. In phase five, the annualized cost to deliver The Healthy Foundation's benchmark of one million packets a day is $27.38 million. This is at a cost of 0.075 cents per packet – less than 10 cents per person per day.

Project Phase	Duration	Product Needed	Total Cost	Cost Per Person Per Day
I	2 months	Approximately 60 packets per day (3,631 total)	$3,226	$0.88
II	1 year	15,000 packets per day (5.475 million total)	$547,500	$0.100
III	1 year	45,000 packets per day (16.25 million total)	$1,396,125	$0.085
IV	1 year	250,000 packets per day (91.25 million total)	$7.3 million	$0.080
V	1 year	1 million packets per day (365 million total)	$27.38 million	$0.075
Total Cost Phases I-V				**$36.63 million**

What the beneficiaries have to say:

Although these are self-reports by some of the homeless people who participated in the pilot project and are not clinically substantiated, clients chose these responses when asked how the vitamin supplements they had received had helped them:

- 59 percent said, "I feel better mentally."
- 50 percent observed, "I feel better knowing that I am getting the vitamins and minerals I need each day."
- 45 percent said, "I feel better emotionally."
- 45 percent noted, "I am sleeping better."
- 41 percent said, "I feel better physically."

In fact, only 9 percent said that they had noticed no differences as a result of participating in the pilot project.

Given the significant potential health and social benefits that vitamin supplements will provide and considering the cost to society to treat the physical, emotional, and mental problems that result if nothing is done, this cost is trivial.

We have an obligation and an opportunity for change. If the United States is to effectively compete in the global economy, we must prepare our children to learn and provide a nutritional safety net for at risk populations.

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Nutrient Literature Review

Many nutrients have been linked with behavior and health. Both excess and deficiency of certain nutrients has been demonstrated to impact mood, cognition or behavior in both human and animal models. The human body lacks the necessary enzymes to synthesize many vitamins, and therefore deficiencies develop without adequate dietary supplementation. *(Stedman's Medical Dictionary, 1995)*. Therefore, a diet deficient in essential nutrients will impact behavior.

Ascorbic Acid (Vitamin C)

Vitamin C cannot be synthesized by humans, and is therefore an essential nutrient in the diet. It is important in biochemical reactions, where it activates oxygen molecules. It is important in the process of building many neuroactive substances that substantially affect behavior, including norepinephrine (NE), growth hormone releasing factor, and neuropeptide Y. The highest concentrations of ascorbic acid in the body are in the adrenal and pituitary glands, where it assists in the formation and regulation of hormones such as adrenocorticotropic hormone (ACTH), which is intimately involved in the sympathetic stress reaction. There is even some evidence that ascorbic acid has a direct behavioral effect in the central nervous system, where it may interact with Dopamine (DA) receptors as an antagonist, and glutamate systems *(Stedman's Medical Dictionary, 1995)*.

The following studies demonstrate that vitamin c status has a profound effect on cognition, behavior and mental illness.

Naylor and Smith (1981) assessed the effect of vitamin C on manic-depressive psychosis in a double blind, placebo controlled, crossover trial. Both manic and depressed patients were significantly better following a single three-gram dose of vitamin C than following a placebo. Kay, Naylor, Smith, and Greenwood (1984) studied the effect of ascorbic acid combined with EDTA in the treatment of manic-depressive psychosis. Patients responded to the ascorbic acid and EDTA combination equally as with conventional therapy with amitriptyline.

In a study of a megavitamin regimen, including vitamin C supplementation, in Attention Deficit Disorder (ADD) 29 percent of 41 subjects showed significant behavioral improvement (Haslam, Dalby, & Rademaker, 1984). A 30-week double blind, placebo-controlled trial used ascorbic acid as a supplemental treatment for autistic children. Significant differences were found with the vitamin C treatment for total scores and also for sensory motor scores, which indicated a reduction in symptom severity (Dolske, Spollen, McKay, Lancashire, & Tolbert,1993).

Subjects given a diet chronically deficient in certain vitamins, including vitamin C, demonstrated many unfavorable psychometric findings. When the subjects

were then given supplementation, they showed improved behavior and cognitive functions (Heseker, Kubler, Pudel, & Westenhofer, 1995).

Cognitive function and mortality were examined in 921 people aged 65 and then followed-up after a 20 year period. Cognitive function was poorest in those with the lowest vitamin C status. The authors concluded that a high vitamin C intake might protect against both cognitive impairment and cerebrovascular disease attributable to aging (Gale, Martyn, & Cooper, 1996).

In another study of vitamin C intake and cognitive impairment conducted with 117 people in a retirement community in Australia, vitamin C intake was assessed at baseline and cognitive function was assessed four years later. Consumption of vitamin C supplements was associated with a lower prevalence of more severe cognitive impairment. (Paleologos, Cumming, & Lazarus, 1998).

Another possible mechanism for vitamin C interaction with behavior involves its role in the synthesis, formation and regulation of adrenocorticotropic hormone (ACTH) , a hormone that, similar to NE, is intimately involved in the sympathetic stress reaction *(Stedman's Medical Dictionary,1995)*. ACTH levels elevate in response to any physical or emotional stress, which leads to increased cortisol secretion. Cortisol has many functions including the stimulation of glucose production in the liver, the mobilization of amino acids from the tissues into the plasma (Guyton, 1986), and the modulating of central nervous system (CNS) function (Porth,1998). Vitamin C deficiency leads to decreased ACTH secretion, which in turn decreases cortisol secretion, thereby impairing amino acid mobilization. The resultant decrease in amino acid mobilization during stress may impair the brain's ability to synthesize necessary neurotransmitters that are amino acid-dependent. The brain would therefore not have the neurotransmitters it needs to react appropriately to stressful situations.

The preceding studies on ascorbic acid demonstrate its vital role in cognitive functioning in pathological states such as manic depression and ADD. Several studies have also indicated a role for ascorbic acid in preserving cognitive functioning in the elderly.

Calcium

> Calcium is the major mineral in the human body, accounting for 2 percent of total body weight. Ninety-nine percent of body calcium is held in skeletal bones and teeth, with the other one percent in plasma and other body fluids as ionized calcium, protein bound, or in organic complexes (Williams, 1989).

Low Calcium levels have been implicated in mental illness.
There is an abrupt increase in serum calcium and phosphorous levels in cases of acute psychosis, which may cause an abrupt decrease of calcium and phosphorous in the cerebrospinal fluid (CSF) that surrounds the brain. Eight psychotic patients given pharmaceutical intervention to increase serum calcium

and plasma levels under double-blind conditions all showed marked increases in agitation. In three psychotic patients undergoing therapy to increase CSF calcium and phosphorous, the severity and frequency of agitated episodes decreased (Carman & Wyatt, 1979). Therefore, decreased availability of calcium and phosphorous to the brain may cause agitation and even psychosis in susceptible people. Studies suggest that antipsychotic medications are only efficacious when calcium and magnesium levels are normal; and that treatment psychoses are related to low calcium and magnesium levels. (Ang, 1995)
In a population-based survey of 3,777 French subjects aged 65 years and older, an inverse relationship between calcium levels in drinking water and cognitive impairment was found (Jacqmin-Gadda, Commenges, Letenneur, & Dartigues,1996). Therefore calcium, similar to vitamin C, may play a role in reducing age related cognitive impairment.

Cobalamin (Vitamin B_{12})

> Vitamin B_{12} acts as a coenzyme in essential biological reactions. High concentrations of it are found in the choroid plexus of the brain, and a deficiency leads to severe, progressive central nervous system deterioration (PubMed, 1999). Cobalamin levels are frequently low in patients with dementia (Carmel et al., 1995), and infants with cobalamin deficiency may demonstrate developmental regression, a movement disorder (Grattan-Smith, Wilcken, Procopis, & Wise,1997), and severe neurological abnormalities (Prakken, Veenhuizen, Bruin, Waelkens, & van Dijken,1994).

The linkage of cobalamin deficiency to psychiatric illness has been studied and debated since these vitamins were first discovered. The pre-clinical evidence for direct effects of cobalamin on brain functioning is compelling, and numerous associations of deficiencies to psychiatric illness are evident. The relationship of cobalamin to dementia is significant, and appears most tightly connected with psychosis. Cobalamin deficiency is a relatively common condition in elderly psychiatric patients (Nilsson et al., 1997).

Karnaze and Carmel (1987) demonstrated that the prevalence of low serum vitamin B_{12} levels was significantly increased at 29 percent in 17 primary degenerative dementia patients compared to 0 percent in 11 secondary dementia patients. Regland, Gottfries, Oreland, and Svennerholm (1988) found that vitamin B_{12} levels were significantly reduced in a group of 66 patients with either senile dementia of the Alzheimer type or confusional states. Fifty percent of the subjects showed vitamin B_{12} concentrations below the lower limit of the normal reference value.

Bell et al. (1990) conducted a chart review study of the serum vitamin B_{12} and folate status of 102 geriatric patients newly admitted to a psychiatric hospital. Those with below the midline values of both vitamins had significantly lower Mini-Mental State scores than patients higher in vitamin B_{12} or folate. Additionally, patients diagnosed with "organic psychosis" with no family history for psychiatric

disorder had significantly lower B_{12} levels than those with a positive family history, implying that B_{12} plays a larger role in non-familial psychosis compared to familial psychosis.

In a New York hospital study, 153 episodes of cobalamin deficiency seen over a 17-year period were examined. A wide variety of neurologic symptoms and signs were encountered, including loss of vision, dementia, psychoses, and mood disturbances. Multiple neurologic syndromes were often seen in a single patient. All patients responded to vitamin B_{12} therapy, and in 47 percent, recovery was complete (Healton, Savage, Brust, Garrett, & Lindenbaum, 1991).

Swiecicki and Rosnowska (1992) investigated the levels of folic acid and vitamin B_{12} in the plasma of 47 patients hospitalized with mental illness. Insufficient amounts of vitamin B_{12} were found in 45 percent of the patients.
In an intervention trial, elderly subjects with low serum cobalamin and evidence of cognitive dysfunction were injected intramuscularly for a minimum of seven months with 1000 micrograms of cyanocobalamin. After a minimum of six months of cobalamin therapy, 11 of 18 patients showed cognitive improvement (Martin, Francis, Protetch, & Huff, 1992).

Low cobalamin levels in demented patients frequently represent mild cobalamin deficiency and are often associated with food-cobalamin malabsorption. Malabsorption is accompanied not only by metabolic changes but also by evidence of mild neurologic dysfunction, which is frequently reversible by cobalamin supplementation (1995).

Over a two-year period, Moelby, Nielsen, Rasmussen, Jensen, and Pedersen (1997) examined 48 patients with plasma cobalamin levels at the lower reference limit. They found that 50 percent of patients with low cobalamin levels had neuropsychiatric disorders. In addition, 28 percent of subjects with low-normal cobalamin levels showed neuropsychiatric disorders.

The relationship between B_{12} deficiency and cognitive impairment was studied in 303 older veterans aged 69 to 85, and found a significant difference between B_{12}-deficient subjects and B_{12} normal subjects on cognitive impairment, with B_{12} normal subjects indicating less cognitive impairment (Bernard, Nakonezny, & Kashner,1998).

The literature supports a strong association between vitamin B_{12} deficiency states and cognitive impairment in both retrospective and prospective trials.

Copper

Copper is an essential trace element in human nutrition. It is absorbed with a binding protein called metallothionein, and transported in the blood by histidine and albumin (Williams,1989). Copper is a component of various proteins. Elevated Copper levels have been implicated in

psychiatric illness and violence. Zinc competes with copper in the body. Supplemental Zinc can lower excess copper levels.

Manser et al. (1989) collected data on mineral levels in 45 psychiatric patients with depression, mental retardation or seizure disorders. The level of copper in each of the groups was significantly higher than in the normal controls.

Wilson's disease, a rare genetic disorder involving increased copper levels in the liver and brain, often initially manifest with psychiatric symptoms. In a case of an adolescent with Wilson's disease who developed psychosis, the symptoms improved after initiation of therapy that decreased plasma copper levels (McDonald & Lake, 1995).

Walsh, Isaacson, Rehman, and Hall (1997) conducted research over the past 20 years on violence-prone individuals. They have observed abnormal trace mineral concentrations, including elevated serum copper and depressed plasma zinc in blood samples. In one study they examined 135 assaultive young males compared to a control group of 18 young males with no history of such behavior. The median Cu/Zn ratio for the assaultive subjects was significantly elevated at 1.40 compared to 1.02 for controls, showing higher then normal levels of copper. Other researchers have reported higher levels of copper in violent offenders (Gottschalk, Rebello, Buchsbaum, Tucker, & Hodges, 1991). Since copper and zinc are absorbed competitively, increasing zinc levels through supplementation will lead to decreased copper uptake and therefore decreased copper in the blood.

Essential Fatty Acids (EFA)

Linoleic and linolenic acid are two fatty acids that cannot be synthesized by the human body. They are essential for proper brain development and function. They serve important functions including maintaining cell membrane integrity, serum cholesterol regulation, blood clotting regulation, and hormonal-like effects (Williams, 1989).

The brain is 60 percent structural lipid, which universally uses arachidonic acid (AA) and docosahexaenoic acid (DHA) for growth, function, and integrity. Experimental evidence in animals has demonstrated that the effect of EFA deficiency during early brain development is deleterious and permanent (Crawford, 1993). There is both retrospective and prospective evidence that maternal EFA nutrition prior to conception is most important to pregnancy outcome. Deficits of brain DHA have been found experimentally to impair visual and cognitive development (Crawford et al., 1993).

Linoleic acid, the precursor of the n-6 fatty acids, has been shown to be below normal in intermittent explosive disorder, while oleic acid, dihomogammalinolenic acid (DGLA) and some subsequent n-6 acids are elevated among habitually violent and impulsive male offenders. Arachidonic

acid metabolites PGE2 and TxB2 are elevated in violent antisocial personality (Virkkunen, Horrobin, Jenkins, & Manku, 1987).

In schizophrenias, there are several lines of evidence for impaired EFA metabolism as well as both direct and indirect evidence of impaired metabolism of PGE1. There is also direct evidence of abnormal EFA biochemistry. There are lower levels of long-chain polyunsaturated analogs of essential fatty acids (EPUFAs) in plasma membrane phospholipids of red blood cells, brain and cultured skin fibroblasts from schizophrenic patients (Mahadik, Shendarkar, Scheffer, Mukherjee, & Correnti ,1996).
Marked depletion of essential fatty acids, particularly arachidonic acid and docosahexanoic acid, have been found in red blood cell membranes from schizophrenic patients relative to healthy control subjects. Changes in diet, which modify membrane levels of fatty acids, can have significant effects upon symptoms of schizophrenia and tardive dyskinesia (TD), lessening the severity of symptoms (Peet, Laugharne, Mellor, & Ramchand, 1996). Lower levels of linoleic acid and higher levels of dihomogamma-linolenic acid are also seen in schizophrenic or schizoaffective disorder patients (Vaddadi et al., 1996)

A study on 10 depressed patients and 14 matched controls measured red blood cell membrane fatty acid levels, and dietary polyunsaturated fatty acids (PUFA) intake. The study found a significant depletion of RBC membrane n-3 PUFA in depressed subjects compared to controls. Severity of the depression correlated negatively with RBC membrane levels and with dietary intake of n-3 PUFAs. The authors concluded that depressive symptoms might potentially be alleviated by n-3 PUFA supplementation (Edwards, Peet, Shay, & Horrobin, 1998).

Folic Acid

Folic acid is one of the B-complex vitamins. It is necessary in transferring single carbon units in many metabolic reactions, including the synthesis of purines, pyrimidines and hemoglobin (Williams, 1989). Folic acid deficiencies typically initially present with psychiatric symptoms, and are related significantly to dementia and depressive disorders (Hutto, 1997). Western and in particular British studies have revealed a substantial rate of low folate in the blood in patients with depression (Lee, Wing, & Fong, 1998).

A study by Godfrey et al. (1990) found that 33 percent of 123 patients with a diagnosis of either major depression or schizophrenia were assessed with borderline or definite folate deficiency. Supplementation of 15 mg of methylfolate daily for six months in addition to standard treatment significantly improved clinical and social recovery compared to controls, a difference that continued to increase over the length of the trial.

Bell et al. (1990) examined the serum vitamin B_{12} and folate status of 102 geriatric patients. Patients with below-median values of either folic acid or cobalamin had significantly lower scores on a cognition and mood test than patients higher

in one or both vitamins. In major depression subjects, folate levels correlated with age at onset of psychiatric illness and length of hospitalization.

Swiecicki and Rosnowska (1992) examined the levels of folic acid in the plasma of patients hospitalized for a variety of mental illnesses. Insufficient levels of folic acid were found in 49 percent of patients. Goodwin, Goodwin, and Garry (1983) evaluated the association between nutritional status and cognitive functioning in 260 non-institutionalized men and women over 60 years who had no known physical illnesses and were receiving no medications. Subjects with low levels of riboflavin or folic acid scored significantly worse on a test of abstract thinking ability.

A placebo-controlled study on 75 patients on lithium therapy administered 200 micrograms of folic daily. Patients who had their plasma folate levels increased by supplementation had a 40 percent reduction in affective abnormalities compared to controls (Coppen, Chaudhry, & Swade, 1986).

The level of folic acid in red blood cells has been shown to have a significant inverse correlation with severity of depression and a significant positive correlation with age of onset of illness. In one study, 99 consecutive unmedicated outpatients with a major depressive illness had blood drawn for measurement of red blood cell folate. While undergoing pharmacological treatment, the change in severity of depression was significantly correlated with changes in folate levels; those that responded to the treatment were significantly likely to show an increase in red blood cell folate (Wesson, Levitt, & Joffe, 1994).

Therefore, supplemental folate can improve mental status.

Iron

> The area of iron deficiency and cognitive problems is probably the best researched of all nutrients. Iron is an essential trace element primarily used in hemoglobin synthesis. Deficiencies manifest as hypochromic, microcytic anemia, while excesses manifest as hemochromatosis or hemosiderosis (Williams, 1989).

Iron deficiency anemia is a highly prevalent nutritional disorder. Research in the last two decades shows that if this nutritional disorder occurs during the first two years of life it is associated with poor psychomotor performance and changes in behavior, such as reduced levels of responsitivy to persons and stimuli, irritability and inhibition. Further studies demonstrate that effects observed during infancy persist in the long term; preschool children who were anemic at twelve months show lower cognitive and motor scores than control children with normal iron nutritional status (De Andraca Oyarzun, Salas Aliaga, de la Parra Cieciwa, & Gonzalez Lopez, 1993). Iron-deficient anemic infants perform worse in tests of mental and motor development than do iron-sufficient infants of a comparable age (Idjradinata & Pollitt, 1993).

A double blind randomized study of 97 children with anemia aged 17 to 19 months gave either iron and vitamin C or vitamin C only (control group) for two months. The children who received the iron had an increased rate of weight gain and more of them achieved the expected rate of development (Aukett, Parks, Scott, & Wharton, 1986).

A case-control study of children with mild to moderate learning difficulties was conducted in Belfast. Children in the learning difficulties group were more likely to be anemic and had lower serum iron and transferrin readings than the children without learning difficulties. Children in the learning difficulties group also scored significantly lower in neurodevelopmental testing than controls. Therefore, children with learning difficulties are more likely to be neurodevelopmentally immature and have low iron status (Corrigan, Stewart, Scott, & Fee, 1997).

Another study evaluated 35 preschool children with an average age of five years and six months. Twenty of these children had been anemic at one year and 15 had normal iron status. Formerly anemic preschool children are less active, more inhibited and timid (De Andraca Oyarzun et al., 1993).

Another study linked early childhood nutrition data and school records. An increased likelihood of mild or moderate mental retardation was associated with anemia or early childhood anemia. These findings support the proposition that efforts to prevent mild and moderate mental retardation should include providing children with adequate nutrition during early childhood (Hurtado, Claussen, & Scott, 1999).

A randomized, double blind trial was done to monitor the effects of iron supplementation on mental performance and motor development among 12 to 18-month-old infants in Indonesia. Iron-deficient anemic infants were assigned randomly to receive dietary iron supplements or placebo for four month. Before supplementation, the average mental and motor scores of the iron-deficient anemic infants were significantly lower than those of the non-anemic iron-deficient and iron-sufficient classes. After intervention, developmental delays were reversed among iron-deficient anemic infants who had received iron but they remained the same among placebo-treated iron-deficient anemic infants (Idjradinata & Pollitt, 1993).

The behavioral effects of iron deficiency and its treatment were evaluated in a double-blind randomized placebo controlled study of 191 Costa Rican infants, 12 to 23 months of age, with various degrees of iron deficiency. Infant development was assessed before and both one week and three months after intramuscular injection or oral administration of iron. Infants with iron deficiency anemia showed significantly lower mental and motor test scores, even after considering factors relating to birth, nutrition, family background, parental IQ, and the home environment. After one week, neither group differed from placebo treatment, however after three months, 36 percent of the children had normal iron levels and no signs of anemia. These children showed normal mental and motor test scores. The majority of initially anemic infants (64 percent) who had more severe or chronic iron deficiency showed no improvement in mental and motor test scores. Although no longer anemic, they still showed biochemical evidence of iron deficiency after three

months of treatment. These persistent lower scores suggest either that iron therapy adequate for correcting anemia is insufficient to reverse behavioral and developmental disturbances in many infants or that certain ill effects are long-lasting, depending on the timing, severity, or chronicity of iron deficiency anemia in infancy (Lozoff et al., 1987). This demonstrates how crucial it is to correct iron deficiency as quickly as possible in children, in order to avoid irreversible damage to motor and mental skills.

Magnesium

Magnesium is present in all body cells, and has widespread metabolic functions. The majority of the magnesium in the body is complexed with calcium and phosphorous in the bone. Metabolically, it is involved in glucose oxidation, protein synthesis, smooth muscle regulation, and cell reproduction and growth (Williams, 1989). Magnesium deficiency is common but difficult to diagnose and to assess in clinical practice (Gullestad et al., 1992). Magnesium-deficient conditions have been associated with neuromuscular and cardiovascular disorders, endocrine disturbances, insulin resistance and Alzheimer's disease (Costello & Moser-Veillon, 1992).

Data suggest an inverted U-shape function to magnesium's influence on behavior. Aggression has been linked to the neurotransmitters dopamine, norepinephrine, and serotonin, and magnesium has been shown to be an important cofactor in the activity of these neurotransmitters (Izenwasser, Garcia-Valdez, & Kantak, 1986). Drug-free depressed patients have higher plasma magnesium levels than controls. Magnesium level tends to normalize in parallel with clinical improvement, and seems then to be related to the intensity of the depression (Widmer et al., 1992).

Plasma magnesium levels were tested in a group of 155 psychiatric in-patients with a variety of diagnoses. The levels were then correlated with the severity of their symptoms. The study found an association for more disturbed and excitable patients to have altered magnesium levels (Kirov, Birch, Steadman, & Ramsey, 1994).

A positive influence of magnesium in the prevention and treatment of hyperactivity in children has been frequently raised in the literature. In one study in children with attention deficit hyperactivity disorder (ADHD), magnesium deficiency was found in 95 per cent of the 116 children examined (Kozielec & Starobrat-Hermelin, 1997).

In animal experiments, magnesium-deficiency increases the stress. However, therapy with magnesium offers protection against these alterations and other manifestations of acute stress (Classen, 1981).

In human trials, magnesium levels (in the spinal cord) were shown to be significantly lower in depressed and suicidal patients. A study of 15 neurological controls and 41 psychiatric patients suffering from major depression showed that

magnesium was found to be significantly lower in both depression and adjustment disorder. Patients who had made suicide attempts had significantly lower average magnesium level irrespective of their diagnosis (Banki et al., 1985). Cerebrospinal fluid (CSF) measurements taken of 275 recently hospitalized psychiatric patients regardless of diagnosis also found that CSF magnesium was significantly lower in the suicide attempters compared to those that had a psychiatric diagnosis, but had not attempted suicide (Banki, Arato, & Kilts, 1986).

Animal studies have shown a relationship between low magnesium levels and increased aggression and susceptibility to stress. In human trials, low magnesium levels have been associated with suicidal behavior, depression and ADHD. Successful antidepressant therapy in depressed patients corresponds with normalization of white blood cell magnesium metabolism (Widmer et al., 1995).

Niacin

Niacin is a B-complex vitamin that serves as a coenzyme in cell reactions. It works in converting proteins and glycerol to glucose, and in oxidizing glucose in two forms, NAD (nicotinamide-adenine dinucleotide), and NADP (nicotinamide-adenine dinucleotide phosphate). Deficiency of niacin results in pellagra, which has dermatological and nervous system effects (Williams, 1989).

There are few studies on niacin and behavior. In a double-blind controlled study lasting four weeks, 25 newly admitted severely depressed patients were randomly assigned to a tryptophan and nicotinamide combination, an anti-depressant medication alone, or a combination of all three. The tryptophan-nicotinamide was shown to be as effective as the anti-depressant medication in unipolar patients, and at low doses may increases the effects of tricyclic antidepressants (Chouinard, Young, Annable, & Sourkes, 1979). In a study of schizophrenics, nicotinic acid supplementation produced significant improvement in symptoms, (Petrie, Ban, & Ananth, 1981), again demonstrating a possible potentiating effect.

Pyridoxine

Pyridoxine is a B-complex vitamin that functions in the body as the coenzyme pyridoxalphosphate. Pyridoxalphosphate is active in many metabolic reactions including the synthesis of the neurotransmitter GABA, amino acid synthesis and catabolism, synthesis of nicotininc acid, amino acid transport, and hemoglobin synthesis. Deficiency of pyridoxine manifests as anemia and central nervous system disturbances (Williams, 1989).

Sixteen autistic-type children who demonstrated improvement of symptoms while on pyridoxine supplementation in a previous study participated in a further such double-blind study. Half were given pyridoxine, and the other half received placebo. The group on placebo that were experiencing pyridoxine withdrawal exhibited significantly deteriorating behavior compared to the group that continued pyridoxine supplementation (Rimland, Callaway, & Dreyfus, 1978).

In another trial on 44 autistic children using pyridoxine combined with magnesium, moderate clinical improvement was found on supplementation with worsening on termination of supplementation. Biochemical data analysis revealed a significant decrease in urinary homovanillic acid (HVA) levels during B6-Mg administration (Lelord et al., 1981; Lelord, Callaway, & Muh, 1982), with normalization of brain EEG evoked potential amplitude and morphology. These changes were not observed when either vitamin B6 or magnesium was administered alone (Martineau, Barthelemy, Garreau, & Lelord, 1985).

A trial of pyridoxine supplementation was conducted on 12 adult celiac disease patients and 12 matched controls. Subjects presented with depression secondary to celiac disease, with no reported change in depressive symptoms after one year's gluten withdrawal despite evidence of improvement in the small intestine. Supplementation with 80 mg per day of pyridoxine significantly decreased scores on a depression test (Hallert, Astrom, & Walan, 1983).

Riboflavin

Riboflavin is a B-complex vitamin that forms coenzymes important in the cellular metabolism respiratory chain. It is also required for chemical reactions, as well as the oxidization of some fatty acids. Deficiency is rare, and manifests with tissue inflammation and breakdown (Williams, 1989).

A study examined 260 noninstitutionalized men and women older than 60 years who had no known physical illnesses and were receiving no medications. Nutritional status was evaluated by three-day food records and also by biochemical determination of blood levels of specific nutrients. Subjects with low levels of riboflavin showed decreased abstract thinking abilities compared to those with riboflavin levels in the normal range (Goodwin et al., 1983).

Selenium

Selenium is a trace element found in greatest concentration in the liver, kidney, heart and spleen, but in all body tissues except fat tissue. It is an essential component of glutathione peroxidase, working with vitamin E to protect cells and membranes from oxidative damage. It is also incorporated into the protein matrix of the teeth, and probably has similar functions in other tissue (Williams, 1989).

In the only study on selenium and behavior, the geographic distribution of selenium deficiency in soil and food was found to be statistically significant with that of high schizophrenia rates in the United States and other countries (Brown, 1994).

Thiamin

Thiamin is another B-complex vitamin that acts as a coenzyme in key metabolic reactions, such as glucose oxidation, and lipogenesis of fatty acids. Deficiency is called beriberi, which manifests as gastrointestinal system dysfunction, neuronal impairment, myelin sheath degeneration and cardiac failure (Williams, 1989).

In human studies, thiamin administration significantly improves recognition accuracy in drug-free cocaine-dependent patients compared to controls (Easton & Bauer, 1997).

Animal studies suggest that thiamin is involved in the presynaptic release of the neurotransmitter acetylcholine. Deficiency of thiamin induces mouse-killing response behavior in rats (Onodera, Kisara, & Ogura, 1979; Onodera, 1987; Onodera & Ogura, 1985), which is related to the dopaminergic neurotransmitter system in the brain (Abe, Tadano, Yonezawa, & Kisara,1987). The mouse-killing behavior may not reverse with subsequent administration of thiamin (Onodera, Yamatodani, & Watanabe, 1993), implying that permanent damage to the brain may occur with deficiency.

Tocopherol

Tocopherol, or vitamin E, is a fat-soluble vitamin that acts as a powerful antioxidant to protect cell membranes form free-radical damage (Williams, 1989).

Cerebral hypoxia (low oxygen levels) has been implicated in the pathogenesis of different neuroses, which may be potentially reversed with vitamin E antioxidant therapy (Airapetiants, 1997).

Zinc

Zinc is an essential trace element with broad metabolic functions in over 20 identified enzymes. It is the second most abundant trace element in the body, and is distributed in many tissues including the pancreas, liver, kidney, muscles, eyes, endocrine glands and prostate. Zinc functions in protein digestion, carbon dioxide transport, and glucose oxidation. Deficiency of zinc manifests as hypogonadism, decreased taste sensation and smelling ability, and impaired wound healing (Williams, 1989).

In animal models, prenatal zinc deficiency induced significantly more aggressive behavior in female rat offspring compared to normally fed female rat offspring. (Halas, Reynolds, & Sandstead,1977). In a study of 45 patients with mental retardation, depression or seizure disorders, female depressives were found to have significantly lower zinc levels compared to normals (1989).

TABLE 1 AGE AND GENDER OF THE HOMELESS

Age and Gender

Surveys conducted by the U.S. Conference of Mayors in 1998 and 1999 examined the age and gender of homeless people in a large number of American cities. Although the results show that the largest group among the homeless is single men, significant numbers of parents and children were also identified among the homeless population. In fact, the number of parents, children, and unaccompanied minors is alarmingly high. Poverty and homelessness are linked to poor health. Lacking the resources to access regular healthcare and inadequate food to supply the daily essential nutrients, the poor and homeless are doubly at risk for health problems. "Food insufficiency" - an inadequate amount of food intake due to lack of resources- is found in the U.S. population of all ages. Food insufficiency results in lower calorie intake and lower intake of macro and micronutrients that are key to immunity, cognitive function and physical health and performance. (NHANES III).

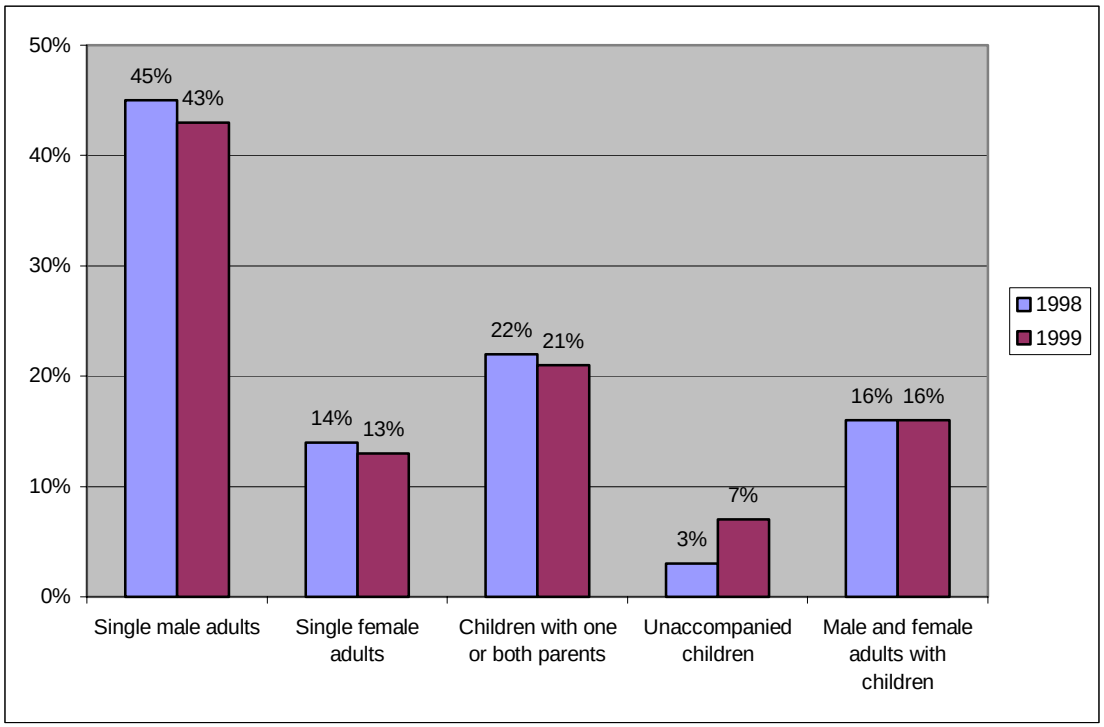

Figure 1. Gender and age distribution of the homeless population in 1998 and 1999.

As Figure 1 demonstrates, 37 percent of the homeless population described in the U.S. Conference of Mayors 1999 survey (U.S. Conference of Mayors, 1999) consisted of children (21 percent) and one or both of their parents (16 percent). Another 7 percent were unaccompanied minors. Thus, 44 percent of the homeless people in this study were children and their families.

TABLE 2 RACE AND HOMELESSNESS

Race

The same 1998 and 1999 U.S. Conference of Mayors surveys also examined the racial composition of the homeless population.

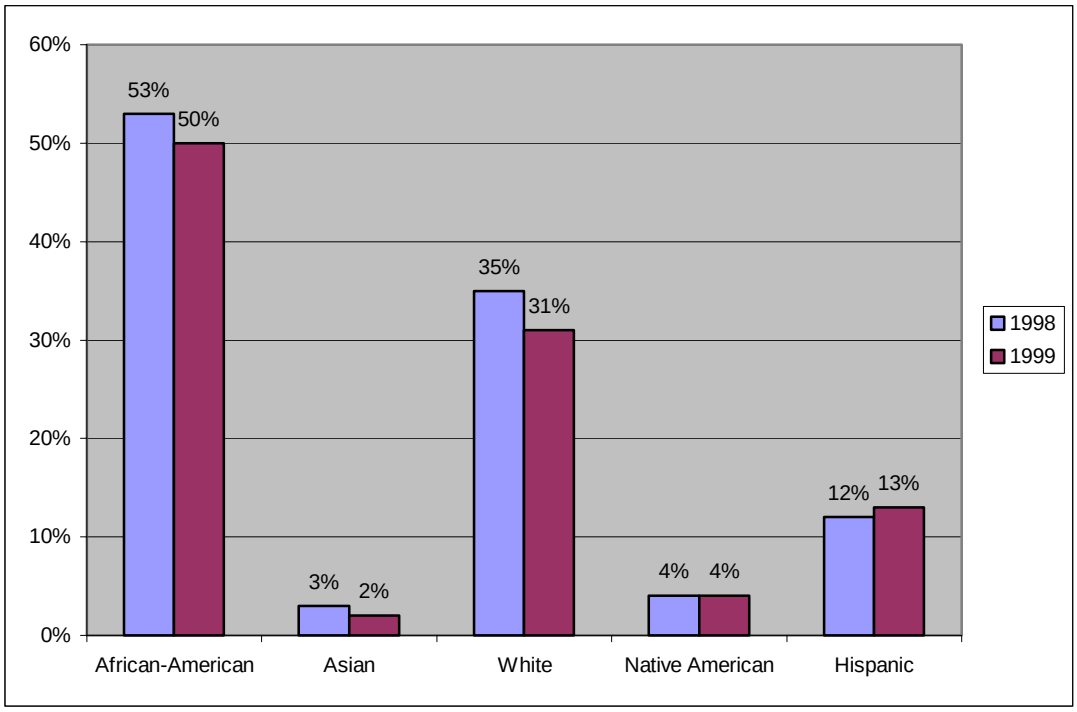

Figure 2. Racial distribution of the homeless population, 1998-1999.

These statistics show that African-Americans are over-represented in the population of homeless people. Distribution by race varies by geographical location and time of the year. For example, the percentage of homeless Native Americans is significantly larger in rural areas than in cities, and homelessness in the largely Hispanic migrant worker population is significantly greater in some parts of the country during certain times of the year.

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