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The Effect of a Mediterranean Diet on All-Cause Mortality in Elderly Individuals: A Systematic Review

Chelsea Van Dyke

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Methods: Exhaustive search of available medical literature in Medline-Ovid, CINAHL, and Google Scholar using the keywords: diet/Mediterranean, mortality, and elderly/aging. GRADE was utilized in assigning the quality of evidence.

Results: Three studies met eligibility criteria. The results showed that a variation of the Mediterranean diet can inversely impact mortality if started at early advanced years of age. The main components of the diet must be included. Moderate alcohol consumption has no impact on the effects of this diet. Dairy and saturated fat intake could decrease longevity if not eaten in moderation.

Conclusion: Studies show benefits to starting a Mediterranean diet at early advanced age in regards to mortality. However, there are many factors associated with this recommendation that need to be further evaluated.

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A Clinical Graduate Project Submitted to the Faculty of the

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Biography

Chelsea Van Dyke is a native of South Dakota. She obtained her undergraduate degree in Athletic Training from the University of Mary in Bismarck, N.D. After completion of this degree she worked to gain clinical experience as an Athletic Trainer, Certified Nurse's Assistant, and Unit Secretary. After completing Pacific University's Physician Assistant Program it is her goal to pursue a career in Family Medicine in an outpatient practice or Urgent Care setting.

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List of Abbreviations

FINE……Finland, Italy, The Netherland, Elderly
HALE……. Healthy Ageing: A Longitudinal study in Europe
HDI……..…..Healthy Diet Indicator
MAI……..... Mediterranean Adequacy Index
MDS……. Mediterranean Diet Score
REF…….Reference Group
SENECA……Survey in Europe on Nutrition and the Elderly: a Concerned Action

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BACKGROUND

Currently the world is in a state of change in healthcare. While the United States becomes deeper and deeper in debt, the search is about finding solutions that decrease costs while maintaining an individual's quality of life. An exciting area of focus is on preventing costs and hardships through wellness. Wellness is multidimensional and takes into account all aspects of body, mind, and soul. Diet is an enormous influence on wellness.

The term diet is heavily associated with countless philosophies and concepts. Currently the general population is immersed in quick and convenient food options. Sadly most Americans eat a diet high in saturated fat, partially-hydrogenated oils, refined carbohydrates, and highly processed foods.[1] Nearly 20 to 40 percent of the five leading causes of death in the United States last year could have been prevented. Three of the five, heart disease, cancer, and stroke, are directly related to improper diet.[2] Published research defines a relationship between certain foods and causes of mortality. For example processed red meat and red meat consumption is directly related to mortality from all causes.[3] Another commonly researched food topic supports increasing consumption of fish which can decrease the risk of mortality from coronary heart disease.[4]

Despite readily available information, the United States still struggles with preventing population dietary influenced disease. The United States is ranked only 42/223 for life span when compared with other countries in the world,[5] even with advances in technology and accessibility to resources. This fact leads researchers to look to those countries that have longer life spans and speculate what they might be doing differently and doing right in comparison. Several countries with life spans longer than the United States including the country with the longest life span, Monaco[5], are bordering or near the region of the Mediterranean Sea. The public noticed this idea and the birth of the Mediterranean diet happened.

A Mediterranean diet is one that is plant based and low in saturated fats. It's key components include fresh vegetables, whole grains, fruits, oily fish, legumes, and wine. Protein is consumed in moderate amounts but red meat is limited to a few meals a month. Olive oil and seasonings are used for flavor avoiding salt and butter. Dairy and refined foods are very restricted. As the Mediterranean diet has become even more popular, actual research[1] has been published suggesting adherence to this diet plan can improve health status and reduce mortality in adults. Completed research has been promising, opening the door to an array of ideas concerning the Mediterranean diet and health. One of those ideas is the effect of a Mediterranean diet on longevity.

In order to apply the idea that a Mediterranean diet might increase longevity one must focus on a specific population of people. Worldwide the populace is aging. If a Mediterranean diet could increase longevity when started later in life some of the

resources used supporting this group of people could be saved. In addition to this, quality of life made better. This study review will look at what research has been done with the elderly population in an attempt to figure out if adopting a Mediterranean diet once already elderly helps decrease the rate of mortality from any cause.

METHODS

An exhaustive search of accessible medical literature was conducted using Medline-OVID, CINAHL, and Google Scholar. The following keywords were used to produce literature: diet/Mediterranean, mortality, and elderly/aging**.** To narrow the search English language studies and those studies involving humans were used. Any studies written before 2000 were excluded. Bibliographies were then reviewed to look for further studies of relevance. Only studies containing information about Mediterranean diet in elderly and the affect it has on mortality rates were included. After the studies were chosen to be part of the review they were evaluated for quality using the Grading of Recommendations, Assessment, Development, and Evaluation (GRADE).[6]

RESULTS

The initial result of the search yielded 27 studies. Studies were then excluded if they were not written in the English Language, were written before 2000, or did not involve humans. Twenty five studies remained which were then carefully inspected for inclusion criteria resulting in three available relevant studies. The remaining three were

valid cohort studies.[7-9] Results of the GRADE assessment are seen in Table 1. A summary of the outcome results from the three studies can be seen in Table 2.

HALE Project

The Healthy Ageing: a longitudinal study in Europe (HALE Project) Cohort study[7] sought to examine a possible connection between food patterns and mortality in elderly individuals. All of the participants were given a diet score based on the food items they chose to eat and were followed up for mortality. The study included 3117 participants aged between 70 and 90. There were 2068 participants who were male and 1049 that were female. Participants included in the cohort were taken from previously finished research The Survey in Europe on Nutrition and the Elderly: a Concerned Action (SENECA) and Finland, Italy, the Netherlands, Elderly (FINE) studies which included participants from 10 different European countries.[9] These studies were chosen because the participants were from various parts of Europe avoiding some genetic influence. The HALE project's investigation of food patterns started in 1988 and ended with the study's completion in 2000.[7]

Within the SENECA and FINE studies[10, 11] trained dieticians were used to conduct a dietary history to collect baseline food consumption of the participants. The participants were to record their food ingestion for 1 month before the initial interview in the SENECA study and 2-4 weeks before the initial interview in the FINE study. The dietary history taken was similar for both studies. To organize the responses, frequency

tables were used in both studies.[11, 12] Information in the tables was categorized via the EUROCODE classification system.[13] This system evades the error that could come with describing the same foods in different languages and cultures.[14] The initial interview also included general health information that could affect mortality such as alcohol consumption, physical activity, number of years of education, and smoking status. It was noted if any of the participants showed prevalence for myocardial infarction, cancer, diabetes, and stroke. This information was confirmed by general practitioners or hospital records in the FINE study but not in the SENECA.[15] Vital status information was available for 99.6% of all participants.[7]

Three different diet scores were created from the information taken to assess a possible relationship between diet and mortality. The first diet score, the MDS (Mediterranean Diet Score),[15] had nine components. These nine components include ratio of monounsaturated to saturated fatty acids, alcohol, legumes/nuts/seeds, cereals, fruit, vegetables and potatoes, meat and poultry, fish, and dairy products. Calories per day were adjusted for women and men. The median value for calories was used as a cutoff point. Diet scores ranged from 0 to 9 with 9 being a high quality diet. Participants scored 1 point for most of the components of their diet that were equal to or higher than the cut off point for their sex. If the participants ate less than the median value of red meat or dairy they scored an additional point. To assure alcohol did not have impact on mortality, the MDS was calculated excluding wine consumption, thus, including only eight components.[7]

The second diet score, the MAI (Mediterranean Adequacy Index), is used to evaluate how close an individual's diet is to the traditional Mediterranean diet.[17] Participants' diets were split into food groups again by the EUROCODE system. Food groups are conveyed as percentages of the total daily intake. The percentages were then split into Mediterranean foods including cereals, legumes, fruit, vegetables, potatoes, fish, monounsaturated fats and wine and non-Mediterranean including milk/milk products, meat and poultry, eggs, sugar, and saturated fat.[7] The percentages were converted to calories and adjusted for men and women.[17] The diet score was obtained by dividing the sum of Mediterranean diet groups by the non-Mediterranean groups. Like the MDS the MAI was done without alcohol excluding wine consumption.[8]

The final diet score, the HDI (Healthy Diet Indicator),[18] was derived from the World Health Organization (WHO) guideline's for prevention of chronic diseases. A point was given to the participant if the person's intake was within the WHO recommendations. If it was not a score of zero was given. Points were awarded if the participant's daily energy intake was less than 10 percent from saturated fats, less than 10 percent from monosaccharides/disaccharides, less than 300mg of cholesterol, between 3-7 percent polyunsaturated fats, between 10-15 percent from proteins, between 50-70 percent from complex carbohydrates, between 27-40 grams of fiber, greater than 400 grams of fruits and vegetables, and greater than 30 grams of legumes, nuts, and seeds. Alcohol was not considered as a factor in this diet score. The median of each of the three

diet scores was calculated. If the individuals scored above the median they were considered to have a healthy diet.[7]

Subjects were organized according to region because different eating patterns exist in the different areas. Those grouped into Northern Europe included Finland, Denmark, the Netherlands, Belgium, and the center in Strasbourg, France. Those grouped in Southern Europe included Italy, Spain, Portugal, Greece, Switzerland, and the center in Valence, France. Before any analysis was done the MAI values were higher in Southern Europe.[7]

By using the Cox proportional hazard model a hazard ratio was created that represented the relationship between the diet scores and mortality over time. Also, hazard ratios of the individual components of the diet scores were executed. To adjust for confounders, baseline gender, smoking, physical activity, BMI, years of education, prevalence of myocardial infarction, stroke, diabetes, and cancer were noted. To further minimize the presence of affect from confounding, the analyses were performed on those without disease or morbidity at baseline and with those who died during the first 2 years of follow-up. This eliminated the outliers that could be caused by generalized very healthy wellbeing or the reverse.[7] Adjustment for center was done to account for dissimilarities between the different study centers such as differences in practices and procedures of that center.[19] The SAS statistical analysis computer software performed the statistical analysis required of all the information collected.[7]

The results showed associating data was found before the hazard ratio statistical analysis was done. The most significant of this was the higher MAI score, with alcohol and without, given to both men and women of southern Europe. The HDI score was 1 point higher for men in southern Europe in the FINE study. There was no difference between northern and southern Europe in the SENECA population. It was found that overall subjects from northern Europe ate more potatoes, eggs, saturated fats, and sugars/sweets while southern Europeans consumed more monosaturated fats, fruits, legumes/nuts/seeds, cereals, complex carbs, and alcohol. To summarize this information southern Europeans ate diets typically associated with a Mediterranean diet more often than northern Europeans.[7]

When looking at the entire population of northern and southern Europeans in both the FINE and SENECA studies, it was found that all three diet scores were inversely associated with mortality. The hazard ratios of the diet scores ranged between 0.78 and 0.89. When looking at northern Europe separately from southern Europe it was established that all diet scores were still inversely associated with mortality but the only scores significant for mortality in groups separately were the MDS and the MAI. The MAI with and without alcohol was significantly inversely associated with mortality in northern Europe but not southern. Furthermore, as diet scores were separated into food groups, it was found that consumption of fruit, fish, cereals, dietary fiber and the Mediterranean component of the MAI were all significantly inversely associated with mortality. Consuming saturated fats was positively associated with mortality.[7]

A 10-year follow-up period was used. There were 659 men and 137 women who died during the 10-year follow-up period in northern Europe. And, 441 men and 147 women died during 10-year follow-up in southern Europe.[7]

The study attributes its advantages to the large number of countries included in the study. The 10 differing countries bring huge amounts of diversity in culture and ancestry as well as a large sample size. Additionally, both the SENECA and FINE studies could be grouped together as they are very similar and had no major differences. The study also presents some disadvantages. The first disadvantage was the EUROCODE classification system for food. This system didn't allow for further separation after aligning food into food groups. For example, vegetables and potatoes had to be grouped together when there is great variability between certain vegetables and potatoes. Similarly, cereals were part of the Mediterranean component of the MAI but cereals can be very dissimilar in ingredients. Other weaknesses included the inability to adjust for all differences in the study center such as quality of staff. These factors are quantitatively unmeasurable.[7]

Hamer et al

The purpose of this study[8] was to inspect an association between diet and mortality in community dwelling individuals from Great Britain. Because community dwelling individuals from Great Britain and only Great Britain were chosen, some of the variation that comes from dietary patterns in different regions and cultures could be

avoided. Individuals included in the study lived in 1 of the 80 sectors chosen from the National Diet and Nutrition Survey of elderly people living in community dwellings in Mainland Great Britain. The local research ethics committee granted approval for each of the sectors.[8] All participants were aged 65 and older.[8,20] A total of 1017 individuals completed the study, 520 men and 497 women. The study started in 1994 and lasted roughly 9 years.[8]

This study chose the gold standard method of a weighed food record with reason. A weighed food record takes a posteriori approach to measuring consumption. Some inconsistencies caused by human understandings of different food amount were avoided by using this method. The method involved issuing each participant a digital scale to weigh out exactly what was eaten. The participant recorded this weight in a food and drink diary which is handed into the interviewer. If food was eaten outside of the institution, participants were to write down exactly what they ate and report it to interviewers. The interviewers then purchased the same food items and weighed them. Participants were asked to do this once every three months for 4 consecutive days lasting a year. By doing it every three months the researchers were able to avoid any possible seasonal variants in participant's food habits and food items available. Interviewers coded each food item and assigned it nutritional value based on the nutrient databank compiled by the Ministry of Agriculture, Fisheries and Food. Similar foods were combined to create 99 food/drink categories. Vitamin and mineral supplementation was recorded and confirmed by fasting blood samples for a subsample of the general

population used. Levels of vitamin C, vitamin E, and carotene were noted. [8,20] Health-related measures included educational status, self-reported physical activity, and smoking status.[19] Nurses recorded BMI and medication use.[21] Participants were asked to rate their health on a scale from very good to poor/bad.[8]

Exploratory factor analysis was completed using principal components and varimax rotation on 99 food/drink categories. Inter-reliability of these factors was assessed by Cronbach's alpha coefficients for standardized variable. A diet score was bestowed on each individual. Then the diet scores were put through Cox proportional hazards model to estimate the risk of mortality according to the diet pattern. The hazard ratios were adjusted for the following confounders: age, gender, education, self-rated health score, smoking status, physical activity, medication use, BMI, total energy intake, and nutritional supplement use. The analysis was done with the entire population and then organized by age, those less than 75 and those older than 75, and gender. It was done again excluding the participants who passed away in the first year of follow-up and those who rated their health as 'very poor' at baseline. The SPSS statistical analysis computer software performed the statistical analysis required of all the information collected.[8]

The results of the factor analysis showed 4 factors that could be further studied, each was associated with a dietary pattern. The 4 dietary patterns were: factor 1; Mediterranean, factor 2; health aware, factor 3; traditional, and factor 4; sweet and fat. Factor 1 or the Mediterranean diet pattern showed the greatest variance. This factor

consisted of foods rich in fruits and raw vegetables, oily fish, coffee, and wine. The health aware pattern followed the Mediterranean and consisted of low-fat/high fiber foods. Next came the traditional pattern consisting of food such as white bread, eggs, bacon and ham, whole meal bread, semi-skimmed milk. Finally the sweet and fat pattern consisting of a diet rich in butter, whole milk, cream, cakes, and puddings. [8]

Before discussing hazard ratios it is important to note some connections were found in respect to dietary patterns. It was more common for the younger participants of the study to consume items from the Mediterranean style and health-aware diet patterns. The sweet and fat style pattern was chosen more as age increased. Those with higher education were more likely to choose a Mediterranean style diet. Women chose the three other diet patterns less than the Mediterranean style. Nutrient blood biomarkers were positively associated with the Mediterranean and health-aware diet patterns.[8]

The study grouped each of the participants according to their adherence to each diet pattern. This was done in highest, middle, and lowest adherence and then put into the Cox model again. The lowest group was given a hazard ratio of one to be compared to the middle and highest groups. The result of this model was an inverse relationship with the Mediterranean style diet pattern and mortality after adjustments. However, a dose response gradient was not found between the middle and highest group after full adjustment. Refer to Table 2 for hazard ratios. All other outcomes were not significant but some patterns found. When the analysis was done separately in two age groups, the Mediterranean diet pattern was more significantly related to mortality in those less than

75 years. In the gender separated analysis only women showed increased longevity with the Mediterranean style pattern and men who consumed a traditional diet had decreased longevity. [8] The analysis done excluding the participants who passed away in the 1st year and had poor base line health produced the same results as the one done with the total population.[22]

Follow up lasted an average of 9 years, where 383 men and women died during follow up. All deaths were required to be recorded within 8 days.[8]

One of the study's major strengths lies in the way in which food was recorded, with such a large population size, by a weighed food record not a questionnaire. Other strengths include the contained sample of participants.[8] Limitations of the study include absence of information about dietary patterns in the earlier lives of the individuals[22] and low variances achieved. The study justifies the low variances by pointing to the fact that the percent variance is a function of the number of food items so it can be used as a relative measurement.[8]

Lasheras et al

The purpose of this study[9] was to evaluate the effects of a Mediterranean diet on elderly nonsmoking people while taking into consideration and controlling for several different confounders that had not been recently studied. The population included 161 nonsmoking institutionalized individuals who were aged 65-90. Of the participants, 112 were women, 49 were men, and all subjects were volunteers. The study separated the

individuals into two groups: those who were 65-80 years and those 80 and greater. It took place in Asturias, northern Spain. Asturias does not boarder the Mediterranean Sea but is considered a Mediterranean country whose diet contains the main characteristics of the typical Mediterranean diet. The participants lived in an institution supported by State Social Security. Two institutions were included in the study. Exclusion criteria included wheelchair or bedridden individuals and those suffering from any terminal illness. The study, which was approved by the Committee on Ethical Research of the Oviedo University Hospital, lasted from March 1989 to December 1998.[9]

The participants were interviewed by trained dietitians using a semi-quantitative food-frequency questionnaire on one occasion and were asked to record their usual diet patterns in daily, weekly, monthly, yearly volume, or by a measurement with a ruler. All amounts were recorded in household units, volume, or measurement with a ruler. If this was not possible participants were asked to compare the food eaten with previously set standards. Food was converted into grams per day and adjusted to daily intakes for men and women. All food was assessed for nutrient and energy contents using the Institute of Nutrition and Bromatology. Participants were allowed to choose daily meals from several set diet menus. Each participant was questioned for possible determinants of diet and health. These included a self-health rating of good, fair, or poor, diet in response to chronic health problems such as hyperlipidemia, diabetes, gastro-intestinal pathology, obesity, and cardiovascular disease and finally physical activity. BMI and vital status was noted. [9]

When this was all finished and a diet score was created. It consisted of 8 components, each contributing to one point of the total score. The components were the high ratio of monounsaturated to saturated fat, moderate ethanol consumption, high consumption of legumes, high consumption of cereals, high consumption of fruits, and high consumption of vegetables, low consumption of meat and meat products, and low consumption of milk and dairy products. Scores ranged from 0 to 8 and median values were used at cut off points.[9]

Once again through Cox's proportional hazards regression hazard ratios were formed. The analysis was done separating the participants into those less than 80 years of age and those greater than 80 years. One analysis was done with respect to the diet score. More were done with each of the 8 components of the diet score individually. These 9 analyses were controlled for the following confounders: age at enrollment, gender, albumin concentration, self-assessment of health, physical activity, BMI, and dieting in response to health conditions. Separate analyses were done for age at enrollment, sex, albumin concentration, dieting in response to chronic conditions, BMI, self-assessment of health, and physical activity which none of these were controlled for. An analysis excluding those who died in the first year was added. Statistical analysis was completed using the SAS software.[9]

Before the analysis was done it was found that those with high diet scores, specifically greater than 4, were more likely to do more physical activity, state that they

were in better health, and were more accountable for their health. Men over 80 years consumed more fruit and dairy products than those under 80 years of age.[9]

After analysis it was found that total diet score was inversely associated with mortality in those less than 80 but not those greater than 80. Instead, a positive relationship between dairy and mortality was found in those older than 80. In the older group high albumin concentration and high self-health rating were inversely associated with mortality. All other individual models and the analysis done excluding those who died in the first year of follow-up did not have meaningful results.[9]

The results showed 96 individuals passed away during the minimum of 9 years of follow up. Thirty-six of these were less than 80 years of age and 58 older than 80 years of age. Of the 36 who died in the younger population 17 were men and 21 female. In the older than 80 groups, 18 of the participants who passed away were men.[9]

Many possible explanations exist as to why individuals over the age of 80 do not have decreased chance of mortality with a Mediterranean diet. Possible explanations include those older than 80 may have to diet according to current disease and earlier life habits had more impact than recent changes. The positive relationship between dairy and mortality is explained by the increase in saturated fat consumption.[23] In summary, this study also found an inverse relationship between mortality and a Mediterranean diet. However, it was only significant in the lower age group.

DISCUSSION

Can diet alone and more specifically a Mediterranean diet impact mortality? According to all three of the studiess,[7-9] a variation of the Mediterranean diet was inversely associated with death in at least some of the age groups considered elderly. The HALE study[7] proved the Mediterranean Diet Score was inversely associated with mortality in its entire population. Although Hamer et al[8] found that the Mediterranean style diet pattern was inversely associated with its entire population, this became more significant when the analysis was done with those less than 75 years of age. Lasheras et al[9] discovered an inverse relationship between Mediterranean style diet patterns with only those less than 80 years old. Most individuals at the beginning of their elderly years could benefit from this style of diet. Further study is needed to determine if effects of the diet are great enough to warrant use in the advanced elderly

Although there were some variations in the data some of the same ideas persisted throughout. The first of these is what is thought to be considered a traditional Mediterranean diet. As stated in the background a Mediterranean diet is one that is plant based and low in saturated fats. Its key components include fresh vegetables, whole grains, fruits, oily fish, legumes, and wine. Protein is consumed in moderate amounts but red meat is limited to a few meals a month. Olive oil and seasoning are used for flavor avoiding salt and butter. Dairy and refined foods are very restricted.[7-9] In fact dairy was positively associated with mortality in two of the three studies.[7,9] Another common area of concern today is the affect alcohol has on our health. Surprisingly the two studies[7,8] that did analysis with and without alcohol found no difference in mortality rates. One of

the studies[7] found mortality to be more inversely associated with a Mediterranean diet when it included moderate amounts of alcohol. Additionally, it is worthy to remember that saturated fats were found to positively associate with mortality in two of the studies.[7,9] The traditional American diet is high in saturated fats and is similar to the traditional diet in Great Britain which was found to also be positively associated with mortality. Saturated fats should be limited in diet. The final important concept found was that an increase in education was associated with food choices more characteristic of the Mediterranean diet. This simply means all individuals need to be educated on what the Mediterranean diet consists of regardless of scholarly and therefore, economic status.[8]

Even with the significant findings in the research review it is evident that more research needs to be completed to adequately assess to what extent the Mediterranean diet impacts elderly individuals. The most important aspect of this is the age component itself. Examining more narrow age intervals could tell us when the diet's affects start to diminish or if more exposure to the diet would communicate into more longevity (demonstrating a dose-response relationship). Furthermore, the available research this review had was limited to populations in Europe. Further data done using more populations in differing nations would be advantageous. Several limitations in the three studies exist reducing the significance of the information found.

The most significant of these was the fact that each of the studies were designed as observational studies. As observational studies, results were already restricted in significance because the study was unable to control for all of the variables affecting

mortality. Nonetheless, all of the studies highlight some very motivating associations that need to be further researched in the form of randomized controlled trials as these trials are more precise.[7-9]

Inconsistency is seen in all three studies.[7-9] The first study, the HALE project[7], and the third study, Lasheras et al[9], had varying populations. The HALE project[7] studied a population which included twice as many men as women and the Lasheras et al[9] included twice as many women as men. This does have the potential skew the results. Other inconsistencies were found in the method of obtaining diet information from the participants. Hamer et al[8] and Hale Project[7] did not specify if the participants were aware that their diets were to be evaluated for Mediterranean elements. Had they known, they could have aligned their diets in this way, thus, not representing a true diet in this population. In Lasheras et al[9] it states the participants were informed of the outcome of the study, making the same chance of inconsistent results even more possible. Another possible discrepancy in dietary assessment method was discovered in both Hamer et al[8] and Lasheras et al[9]. In Hamer et al[8] participants were asked to keep record of their food intake for 4 consecutive days. It does not specify but if the participants were allowed to choose those 4, they could have easily eaten differently or possibly healthier during those days. Lasheras et al[9] allowed the participants to indicate their usual patterns of food intake in daily, weekly, monthly, or yearly basis. Once again this grants them control of over what is being recorded as their diet.

Even with limitations, the studies did have some strengths. In all three of the studies the data was found to be significant with appropriate 95% confidence intervals and P values less than 0.05. The studies themselves were not published as a consequence of bias. Table 1 illustrates all of the limitations and advantages noted here.[7-9]

CONCLUSION

The elderly population is growing in numbers and with this comes an increase in their economic and health care needs. Implementing a Mediterranean style was found to increase longevity when started in the advanced stages of life. The earlier the diet is started, the more significant the changes can be. A Mediterranean diet is one that replaces saturated fats with monosaturated fats. Ideally dairy intake is minimal in this diet which is further supported by the information found in the studies reviewed here. Although an inverse relationship between Mediterranean diet and mortality was found in all three studies reviewed, this relationship needs to be studied further. Initiating a new study with defined elderly age intervals would examine to what extent the diet impacts age. Using a population from the United States would be useful to further apply to practice. The type of study used for further research may need to be changed in insure more accurate data. The idea, however, should stay the same.

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Table 1. Characteristics of Reviewed Studies

Quality Assessment							
		Downgrade Criteria					*Quality*
Study	*Design*	*Limitations*	*Indirectness*	*Imprecision*	*Inconsistency*	*Publication bias likely*	
Mortality							**Low**
HALE Project[7]	Observational	Not Serious	Not Serious	Not Serious	Not Serious	No	Low
Hamer et al[8]	Observational	Not Serious	Not Serious	Not Serious	Serious[a]	No	Very Low
Lasheras et al[9]	Observational	Not Serious	Not Serious	Not serious	Serious[b]	No	Very low

[a] Inadequate information regarding food record schedule.

[b] Study's objective was revealed to participants and inconsistency found in how the diet intake was recorded.

Table 2. Summary of Findings

Study	*Diet Pattern*	*Number of Deaths During Follow Up*	*Hazard Ratios for Mortality (95 % confidence Interval)*		
			Total Population	Northern Europe	Southern Europe
Hale Project[7]	MDS	1382/3117	0.82 (0.75-0.93)	0.83 (0.74-0.93)	0.88 (0.78-0.98)
	MDS w/o Alcohol		0.78 (0.71-0.87)	0.89 (0.77-1.02)	0.92 (0.84-1.02)
	MAI		0.83 (0.75-0.92)	0.79 (0.74-0.85)	0.96 (0.86-1.08)
	MAI w/o Alcohol		0.87 (0.79-0.97)	0.83 (0.74-0.92)	0.97 (0.86-1.10)
	HDI		0.89 (0.81-0.98)	0.93 (0.85-1.02)	0.93 (0.84-1.02)
			Lowest	Medium	High
Hamer et al[8]	Mediterranean	683/1017	1 (REF)	0.81 (0.67-0.97)	0.82 (0.68-1.00)
	Health Aware		1 (REF)	1.04 (0.86-1.25)	0.93 (0.76-1.13)
	Traditional		1 (REF)	0.94 (0.78-1.15)	1.15 (0.94-1.40)
	Sweet and Fat		1 (REF)	1.02 (0.84-1.24)	0.93 (0.75-1.15)
			< 80 years	> 80 years	
Lasheras et al[9]	Mediterranean	96/161	0.69 (0.43-0.93)	1.24 (0.60-2.53)	