

UNIVERSITY OF SÃO PAULO

FCF/FEA/EACH

Interunits Graduate Program in Applied Human Nutrition - PRONUT

Adherence to the Mediterranean dietary pattern and Common mental disorders in elderly
living in São Paulo-SP-Brazil: population-based study

Amália Almeida Bastos

Dissertation presented to the Interunits Graduate Program in
Applied Human Nutrition – PRONUT, University of São
Paulo, as final requirement for the Degree of Master of
Science.

Supervisor: Associate Professor Sandra Maria Lima Ribeiro

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São Paulo, _____, 2019

ACKNOWLEDGMENTS

First, I thank God for life, for all his kindness and mercy, for providing me this incredible opportunity and especially for guiding me during all my life.

My dear supervisor, Associate Professor Sandra Maria Lima Ribeiro for the confidence placed in me for the accomplishment of this work, for patience, for sharing with me a little of her enormous knowledge over these almost three years. Thank you for welcoming me with so much affection, for all the advice, for always encouraging me to follow challenging paths, for all readings and minute corrections, for all your kindness and dedication as a supervisor. I am and will be eternally grateful for this opportunity.

Thanks to the researchers of the Food Consumption Research Group (GAC), especially to Professor Regina Mara Fisberg, for this opportunity and suggestions for the development of this work. Thank you immensely for the student Luana Romão, for all her availability, patience and help, Aline Veroneze and Mariane Melo for their patience in providing all the necessary information.

Thank you to all researchers and institutions involved in 2015 ISA-Capital.

To my parents, Antônio Alberto (Bebeto) and Admildes (Mida) who have always been present in all phases of my life and who have always supported me and encouraged me to move forward in all the difficult moments. Thanks for all dedication over the years to provide me and my sisters with the best opportunities, for always giving us love, care and attention and always seek to guide us in the face of important decisions. I love you.

My sisters, Aline and Amanda, who were my eternal companions along this trajectory. I thank every advice, all the words of encouragement, support and for always being by my side. You are the best sisters I could ever have.

To all my family that always gives me a lot of affection and vibrates with all my achievements. Special thanks to my uncles, Ana Dalva and Benedito, and to the cousins / brothers, Leandro and Rafael, for having welcomed me with open arms and for all the love and care they gave to me, without you I would never have gotten here.

I thank Mônica Batalha, for the years of friendship, for all the support, for all the words of encouragement, for all her help and for always sharing with me her knowledge. I will always be rooting for your achievements as well.

I also thank my friend Emilene Maciel, for encouraging me to always give my best.

My gratitude to the NAFE Research Group for all the shared knowledge and for all the exchange of experiences throughout the period. Thanks to João for his willingness to help, Shirley for her partnerships and encouragement talks and Camila Melo for her kindness, advices and encouragement.

Thank you to Gisele, who welcomed me with great affection.

The friendships that I built through the university, especially Renata Alves and Mariana Ávila, for the shared moments and for making this walk lighter and more fun.

I would like to thank the University of Sao Paulo, especially the faculties that constitute the Interunit Graduate Program in Applied Human Nutrition - PRONUT by the opportunity. I thank the staff of the program, especially Irineu and Sueli for their help and guidance in carrying out some activities as a student.

Thank you to the professors of disciplines concluded by all knowledge acquired.

I thank the researchers who participated in the Qualifying Exam for all the suggestions for the development of the work. I also thank the judging committee who accepted to participate in the defense examination of this work. Thank you for all contributions.

To my dear undergraduate teachers for being part of my formation as a nutritionist, to be a source of inspiration and to encourage me to seek new knowledge and new experiences.

Thank you to Coordination for the Improvement of Higher Education Personnel (CAPES) for providing me a scholarship.

Finally, I am very grateful to everyone who contributed directly or indirectly to the conclusion of this stage in my life. Without you none of this would have been conquered.

I love you all. Thank you for everything and for being part of my life.

“A menos que modifiquemos a nossa maneira de pensar, não seremos capazes de resolver os problemas causados pela forma como nos acostumamos a ver o mundo”.

(Albert Einstein)

RESUMO

Bastos, A.A. **Adesão ao Padrão da dieta mediterrânea e Transtornos Mentais Comuns em idosos de São Paulo-SP-Brazil: estudo de base populacional**. 2019. 83f. Dissertação (Mestrado) - Programa de Pós-Graduação Interunidades em Nutrição Humana Aplicada – PRONUT, Faculdade de Ciências Farmacêuticas, Faculdade de Economia, Administração e Contabilidade e Escola de Artes, Ciências e Humanidades, Universidade de São Paulo, São Paulo, 2019.

Introdução: A presença de Transtornos mentais comuns (TMC) torna-se mais frequente com o avançar da idade. A literatura evidencia os efeitos benéficos da Dieta mediterrânea sobre a saúde mental do idoso, porém poucos estudos foram realizados em países ocidentais. Ademais, os estudos realizados em regiões não mediterrâneas geralmente não levam em consideração as peculiaridades dos alimentos, que nem sempre atendem a todas as características mediterrâneas.

Objetivos: (i) descrever a adesão ao padrão da dieta mediterrânea considerando dois pontos de vista: incluindo apenas alimentos característicos do original padrão da dieta mediterrânea e incluindo alimentos com características não mediterrâneas (ii) verificar a associação entre a adesão aos dois padrões da dieta mediterrânea (PDM) construídos e TMC em idosos. **Métodos:** trata-se de um estudo transversal de base populacional; foram utilizados dados do Inquérito de Saúde de São Paulo 2015 (ISA-Capital). A presença de TMC foi identificada através do *Self Reporting Questionnaire-20*. O PDM foi construído através do Escore da dieta mediterrânea (calculado com base em dois recordatórios alimentares de 24h), considerando dois pontos de vista: Padrão mediterrâneo similar ao original (PMSO) – com a inclusão de apenas alimentos originais da dieta mediterrânea; Padrão mediterrâneo com características não mediterrâneas (PMNM) – com a inclusão de alimentos que foram submetidos a procedimentos que divergem do padrão mediterrâneo original. As demais variáveis foram identificadas por meio de um questionário previamente estruturado. A associação entre TMC e a adesão ao PMSO e PMNM foi investigada por meio de modelos de regressão logística. As covariáveis para o ajuste foram selecionadas por plausibilidade biológica. Adotou-se nível de significância de 5% ($p < 0,05$) para os testes estatísticos finais. Todas as análises de dados foram realizadas utilizando o *software* Stata (versão 14). Para atender os objetivos da presente pesquisa, foram elaborados dois manuscritos. O manuscrito 1 teve como objetivos (i) descrever o grau de adesão ao PMD por idosos de São Paulo-SP-Brasil; (ii) construir dois pontos de vista do PMD, de acordo com as modificações frequentes na forma de ingestão dos diferentes componentes desse padrão

dietético, investigando associações com variáveis demográficas e socioeconômicas. O manuscrito 2 teve como objetivos: (i) avaliar a associação entre a aderência ao PMD e transtornos mentais comuns nesses idosos; (ii) investigar essas associações levando em consideração as duas visões construídas para esse padrão. **Resultados:** No manuscrito 1 foi encontrada uma adesão moderada pelos idosos às duas visões do PMD. A maior adesão a ambas as visões do PMD foi caracterizada pela ingestão mais elevada de vegetais, frutas, oleaginosas, cereais, leguminosas e maior proporção de lipídios monoinsaturados e saturados, além de um menor consumo de carne e laticínios. O PMSO e o PMNM apresentaram associação com escolaridade e idade, respectivamente. No Manuscrito 2, identificou-se que as adesões moderada e alta ao PMSO, em comparação a uma baixa adesão, foram associadas a uma menor prevalência de TMC, após ajuste para sexo, idade, índice de massa corporal, número de doenças crônicas, renda domiciliar per capita, atividade física e tabagismo. Por sua vez, a presença de TMC não mostrou associação significativa com nenhum grau de adesão ao PMNM. Adicionalmente, a presença de TMC foi significativamente diferente entre os gêneros, a atividade física e o número de doenças crônicas referidas. **Conclusões principais (a partir de ambos os manuscritos):** o efeito protetor de uma maior adesão ao PDM sobre os TMC em idosos foi observado apenas quando as particularidades originais desse padrão foram atendidas. Outros fatores, associados ao estilo de vida, mostraram-se importantes para melhorar as associações com TMC. Os resultados encontrados reforçam a importância de programas que incentivem a manutenção de hábitos alimentares saudáveis entre idosos.

Descritores: Idoso; Dieta Mediterrânea; Padrão da dieta mediterrânea; Transtornos Mentais Comuns.

ABSTRACT

Bastos, A.A. **Adherence to the Mediterranean dietary pattern and Common Mental Disorders in elderly living in São Paulo-SP-Brazil: population-based study**. 2019. 83p. Dissertation (Master's degree) - Interunits Graduate Program in Applied Human Nutrition – PRONUT, School of Pharmaceutical Sciences, Faculty of Economics, Administration and Accounting and School of Arts, Sciences and Humanities, University of São Paulo, São Paulo. 2019.

Introduction: The presence of Common Mental Disorders (CMD) becomes more common with advancing age. The literature shows the beneficial effects of the Mediterranean Diet on the mental health of the elderly, but few studies have been conducted in Western countries. In addition, studies conducted in non-Mediterranean regions generally do not take into account the peculiarities of food, which do not always meet all the Mediterranean characteristics.

Objective: (i) to describe the adherence to the Mediterranean dietary pattern, considering two points of view: including only foods characteristic of the original standard Mediterranean diet and including foods with non-Mediterranean characteristics (ii) to verify the association between the adherence to the two Mediterranean Dietary Patterns (MDP) and CMD in the elderly. **Methods:** cross-sectional population-based study; Data from the 2015 Health Survey of São Paulo were used. The presence of CMD was identified through the Self Reporting Questionnaire-20. The MDP was constructed using the Mediterranean Diet Score (calculated from data from two 24-hour dietary recall), considering two points of view: Mediterranean pattern origin-like (MPOL), which included only foods from the original Mediterranean diet; Mediterranean pattern including foods with non-Mediterranean characteristics (MPNM), which included foods submitted to procedures that diverge from the original dietary pattern. The other variables were identified through a previously structured questionnaire. The association between TMC and adherence to MPOL and MPNM was investigated through logistic regression models. The covariates for the adjustment were selected for biological plausibility. A significance level of 5% ($p < 0.05$) was considered for final statistical tests. All data analyses were performed using Stata software (version 14). To accomplish the objectives of the present research, two manuscripts were elaborated. The aims of the 1st manuscript were: (i) describe the degree of adherence to this dietary pattern by elders from São Paulo-SP-Brazil; (ii) to identify modifications made in the form of intake of the different components of the original MDP, investigating associations with demographic and socioeconomic variables. The aims of

the 2nd manuscript were: (i) To evaluate the association between the adherence to the MDP with the presence of mental disorders in these elders; (ii) To investigate these associations taking into account the two different points of view of MDP. **Results:** The 1st manuscript showed a moderate adherence to the two views of MDP. The greater adherence to the two proposed dietary patterns was characterized by higher intakes of vegetables, fruits, nuts, cereals, legumes and greater proportion between monounsaturated and saturated lipids and, as well as lower consumption of meat and dairy products. MPOL and MPNM were associated with formal education and age, respectively. From the 2nd manuscript, we identified that moderate and high adherence to MPOL, compared to low adherence, was associated with a lower prevalence of CMD, after adjustment for gender, age, body mass index, number of chronic diseases, *per capita* household income, physical activity and smoking status. The presence of CMD was not associated with MPNM adherence. Additionally, the presence of CMD was different between gender, physical activity and number of referred chronic diseases. **Main conclusions (from the two manuscripts):** the protective effect of MDP on CMD in elderly was observed only when the particularities of this diet were fulfilled. Other factors, associated to lifestyle, showed to be important to improve the associations with CMD. The results support the importance of programs that encourage the maintenance of healthy eating habits among the elderly.

Key-words: Elderly; Mediterranean diet; Mediterranean dietary pattern; Common Mental Disorders.

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LIST OF ABBREVIATIONS

CAPES	Coordination of Superior Level Staff Improvement
CNPq	National Council for Scientific and Technological Development
NCDs	Chronic noncommunicable diseases
CVD	Cardiovascular diseases
DM2	Type 2 diabetes mellitus
MDS	Mediterranean dietary score
FAPESP	São Paulo Research Foundation
IBGE	Brazilian Institute of Geography and Statistics
BMI	Body Mass Index
IPAQ	International Physical Activity Questionnaires
ISA-SP	Health Survey of São Paulo
MPM	Multiple Pass Methods
MDP	Mediterranean dietary pattern
MPOL	Mediterranean pattern origin-like
MPNM	Mediterranean pattern with non-Mediterranean procedures
MSM	Multiple Source Method
NDSR	Nutrition Data System for Research
FFQ	Food frequency questionnaire
R24h	24-hour dietary recall
ACS	Acute coronary syndrome
SMS-SP	Municipal Health Secretariat of São Paulo
SQR-20	Self Reporting Questionnaire 20
TACO	Brazilian table of food composition
CMD	Common Mental Disorders
USDA	United States Department of Agriculture
WHO	World Health Organization
TNF α	Tumor necrosis factor
IL-6	Interleukin 6
IL-1 β	Interleukin 1 beta
PCR	Protein C-reactive
ROS	Reactive oxygen species

1. INTRODUCTION

1.1 AGING AND COMMON MENTAL DISORDERS

The world population has undergone perceptible changes related to its age structure, with evidence of an accelerated population aging during the last years. This is the result of increased life expectancy and declining fertility, which is expected to intensify in the coming decades, especially in less developed regions (United Nations, 2013; United Nations, 2015). By 2015, a number of 901 million people worldwide were aged 60 or older and it is estimated that by 2050 this number will overcome the double, achieving almost 2.1 billion. Globally, there is faster growth in the number of people aged 80 years or more, compared to the number of older people in general, with projections suggesting more than a tripled increase between 2015 and 2050 (125,3 million to 434,4 million) (United Nations, 2015).

Projections indicate faster growth in the number of people aged 60 years and over and 80 years or more in Latin America and Caribbean between 2015 and 2030, with an increase of 70.6% and 81.4%, respectively (United Nations, 2015). In Brazil, over the same period, estimates show that the number of elderly (60 years or older) will increase significantly from 23.9 million (11.7%) to 41.5 million (18.6%) and the increase will be from 3.3 million (1.6%) to 6.5 million (3%) among the oldest age groups (80 years and over) (IBGE, 2013). According to data from IBGE (2013), the largest population of elderly people live in the state of São Paulo, currently with almost 7 million people aged 60 or over.

Concomitant to changes in the age composition of the population, there is an increase in the prevalence of chronic noncommunicable diseases (NCDs) and disabilities, due to physiological changes inherent in the aging process. This increase may compromise the health of the elders and consequently their social interaction in which they are inserted (United Nations, 2013; Dziechciaż and Filip, 2014; King and Lipsky, 2015). Among this group of diseases, the presence of mental disorders deserves especial importance. These disorders can be triggered to a number of bio-psycho-social factors, such as damages in the functioning of organism systems, increased number of chronic diseases, limitations of functional capacity, interruption of work, reduction of income, isolation and social deprivation, losses of friends and family and other events that generate stress (Dziechciaż and Filip, 2014; King and Lipsky, 2015).

Among different aging-related biological changes possibly associated to mental disorders, a disproportion between proinflammatory and anti-inflammatory mediators can be

observed. This disproportion is called, by some authors, inflammaging (Franceschi *et al.*, 2000), and some hypotheses try to clarify its related mechanisms: imbalance in immune system response to stressors from immunosenescence; increase of adipose tissue, especially in the abdominal region with inflammatory characteristics, which favors the release of inflammatory cytokines; increased intestinal permeability and consequently the bacterial translocation for systemic circulation followed by inflammatory condition in different tissues (Franceschi *et al.*, 2000; Franceschi *et al.*, 2007;). The progressive increase of this proinflammatory condition may be related to the development of chronic diseases, sarcopenia, frailty, mental disorders, among others (Xia *et al.*, 2016; Ferrucci and Fabbri, 2018; Baylis *et al.*, 2014).

Common mental disorders (CMDs), also called minor psychiatric disorders, are characterized by physical and psychic symptoms, including depressive thoughts, anxiety states, irritability, fatigue, insomnia, difficulty in memory and concentration, and somatic complaints (Goldberg *et al.*, 1994). Depressive and anxiety disorders refer to the two main categories of CMD (WHO, 2017). Their presence is associated to worsening of quality of life, physical disorders and increased use of health services (Penner-Goeke *et al.*, 2015; Sunderland *et al.*, 2015).

The prevalence of CMD in the general population can reach 30% (Goldberg and Huxley, 1992). In 2015, the global prevalence of anxiety and depression was identified as 4.4% and 3.6%, with a peak prevalence of depressive disorders between men and women aged 60 and 64 years (approximately 5.5% and 8%, respectively) (WHO, 2017). A multicenter study conducted in Brazil found the prevalence of 51.9%, 53.3%, 64.3% and 57.7% among primary care users in Rio de Janeiro, São Paulo, Fortaleza and Porto Alegre respectively (Gonçalves *et al.*, 2014). Other studies, using the same instrument to identify CMD and different from the multicenter study cited above, found lower occurrence among elderly people living in low-income areas of the western region of São Paulo (43.1%), Campinas (29,7%) and in the municipality of Jequié, Bahia (47.4%) (Coutinho *et al.*, 2014; Borim *et al.*, 2013; Pinto *et al.*, 2014).

There are different instruments in the literature to identify CMD. Among them, the Self Reporting Questionnaire 20 (SRQ-20) is recommended by the World Health Organization (WHO) to investigate the general population (Harding *et al.* 1980). Its structure includes 20 questions that must be answered as "yes" (equal to 1 point) or "no" (equal to 0 points), and its score can range from 0 to 20 points. Although this tool cannot be used to diagnose specific disorders, its application as a screening method allows the early identification and, thus, the prevention of developing major disorders in the future. In Brazil, the SRQ-20 was validated

from a study performed in primary care in São Paulo, with a score equal to or greater than 8 as a cutoff point to identify the presence of CMD in the general population (Mari and Williams, 1986).

1.2 MEDITERRANEAN DIETARY PATTERN (MDP)

Evaluating diet as an exposure variable is a complex process in nutritional epidemiology. Traditionally, research on nutrition was focused on specific nutrients or foods and, in this context, was used as scientific evidence for the development of the current food recommendations (Hu, 2002). However, when considering that individuals do not consume isolated foods, it is important to highlight that a given food and its nutritional components may be influenced by the action of other food components; as such, it has been currently proposed the study of dietary patterns (Hu, 2002; Willett, 1998).

The study of dietary patterns allows us to evaluate the cumulative effect of various foods and nutrients, pertaining to food practices of populations, in the prevention or treatment of various diseases (Hu, 2002). Two approaches are described to define dietary patterns: a hypothesis-oriented approach (dietary patterns defined a priori), based on the elaboration of indexes and scores according to the adherence to the consumption of various foods and/or previously determined nutrients. An example of this type of analysis is the assessment of adherence to the Mediterranean dietary pattern. The exploratory approach is the other possibility to study dietary patterns (dietary patterns defined a posteriori), and is based on statistical techniques that identify foods consumed together, strongly interconnected and previously unknown (Schulze and Hoffmann, 2006; Kant, 2004; Panagiotakos *et al.*, 2009).

The term Mediterranean diet has been used since the early 1960s to describe the food habits characteristic of populations living near to the Mediterranean Sea, mainly in various regions of Greece and southern Italy, and more specifically olive growing areas (Willett *et al.*, 1995; Trichopoulou and Lagiou, 1997). Traditionally, this dietary pattern is characterized by high intake of vegetables, fruits, nuts, cereals (most unrefined), moderate to high fish consumption (varying according to the proximity of the sea), low saturated and high unsaturated lipid intake, mainly from olive oil; low to moderate intake of dairy products (mainly cheese and yogurt), low consumption of red meat and its derivatives; and moderate consumption of alcohol, mainly in the form of wine, and during meals (Willett *et al.*, 1995). In addition, some characteristics of these foods are emphasized such as fresh, locally produced, and with minimal industrial processes (Martínez-González *et al.*, 2017; Hachem *et al.*, 2016).

The first publications involving the Mediterranean diet recorded in the literature came from a study which began in the late 1950s, called "Seven Country Studies" (Keys *et al.*, 1980). The original design of this study was based on the cultural comparison, including lifestyle and diet (nutrients, foods and dietary patterns), among seven countries (United States, Japan, Finland, Netherlands, Italy, Greece and Yugoslavia). After the first 25 years of follow-up through 16 cohorts, lower incidences of coronary heart disease were found in countries where dietary habits were based on the Mediterranean diet.

Recommendations based on the Mediterranean diet are generally represented by a food pyramid, indicating that the specified foods at the base, middle and top should be consumed in daily, weekly and monthly portions respectively. The first pyramid proposed to represent the traditional Mediterranean diet was based on the food habits of regions of Greece and southern Italy, later adapted (Willett *et al.*, 1995; Oldways Preservation & Exchange Trust, 2009). Over the years, some variations of the pyramid were performed, with some modifications and adaptations, in order to specifically represent both the recommendations for other populations, and for the same Mediterranean populations living in modern times (Supreme Scientific Health Council, 1999; CIISCAM, 2009; Bach-Faig *et al.*, 2011).

In order to identify the MDP, food consumption data were obtained through the application of a semiquantitative food frequency questionnaire (FFQ) from a study of 182 elders living in rural villages in Greece. The objective was to evaluate the influence of a specific dietary pattern on overall survival in this population. In that study, scores were attributed to the exposure to eight food and nutrients components (vegetables, legumes, fruits and nuts, dairy products, cereals, meat and meat products, alcohol, monounsaturated/saturated fat ratio) and, thus, creating the first Mediterranean diet score (MDS); later, this score was reviewed with the inclusion of fish consumption, thus generating nine components (Trichopoulou *et al.*, 1995; Trichopoulou *et al.*, 2003).

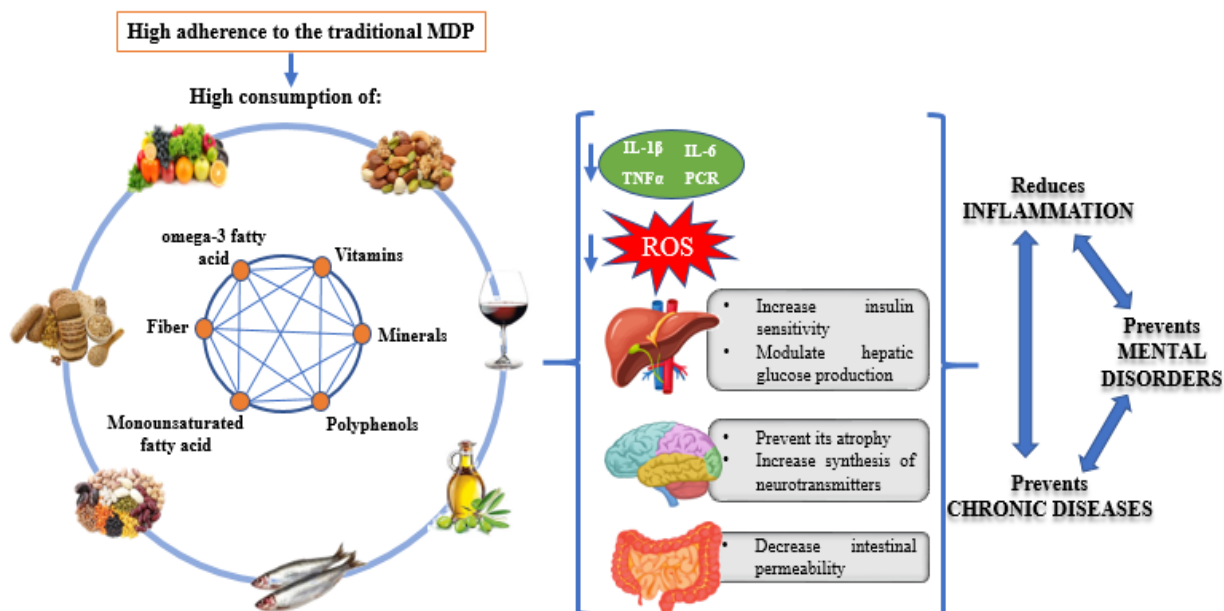
Therefore, MDS is a method to evaluate the adherence to the MDP. From the original MDS several variations appeared, with some differences, due to modifications in the methods for its calculation. These variations were designed to assess the adherence to the MDP in other European populations and in Western countries such as the United States and Canada (Gerber *et al.*, 2000; Sánchez-Villegas *et al.*, 2002; Goulet *et al.*, 2003; Fung *et al.*, 2005; Trichopoulou *et al.*, 2005; Rumawas *et al.*, 2009; Schroder *et al.*, 2011). Although there are differences in the method used to evaluate the adherence to this dietary pattern, MDS variations basically include the same original components of this diet, maintaining their main characteristics.

1.3 ADHERENCE TO THE MEDITERRANEAN DIETARY PATTERN AND COMMON MENTAL DISORDERS IN ELDERLY

In general, the dietary components that characterize the Mediterranean diet, include sources of important nutrients and phytochemicals. Some of them can be mentioned; dietary fiber, monounsaturated and omega-3 polyunsaturated fatty acids, vitamins, minerals and polyphenols (Widmer *et al.*, 2015; Moore *et al.*, 2018). The interaction between these nutrients optimizes their beneficial actions to the organism. Some physiological aspects involved can be mentioned: reduction of the levels of proinflammatory cytokines such as tumor necrosis factor (TNF α), interleukins 6 (IL-6) and 1 beta (IL-1 β) and protein C-reactive (PCR) (Yarla *et al.*, 2018; Hussain *et al.*, 2016); inhibition of enzymes involved in the production of reactive oxygen species (ROS) and stimulation of the expression of antioxidant enzymes, consequently reducing oxidative stress (Hussain *et al.*, 2016; Rahimi *et al.*, 2005); improvement of insulin resistance and modulation of hepatic glucose production (Aryaeian *et al.*, 2017); maintenance of the cerebral structure and function, preventing its atrophy and favoring the synthesis of neurotransmitters (Pribis and Shukitt-Hale, 2014; Gómez-Pinilla, 2008); improvement of intestinal permeability and bacterial translocation (De Santis *et al.*, 2015; Wu *et al.*, 2011).

Based on these possible functions, the impact of adherence to the Mediterranean dietary pattern on health is extensively studied. Researches have shown that food habits closer to the Mediterranean diet can reduce the risk of mortality and NCDs such as obesity, type 2 diabetes mellitus (DM2), cardiovascular diseases (CVD) and neoplasia, and also have protective effects for depression and delay cognitive losses in neurodegenerative diseases such as Alzheimer's and Parkinson's disease (Sofi *et al.*, 2013; Tyrovolas and Panagiotakos, 2010; Trichopoulou *et al.*, 2005; Schroder *et al.*, 2011; Moore *et al.*, 2018). Therefore, most of these processes are important to brain function, as illustrated in Figure 1.

Figure 1. Effects of Mediterranean diet components on mental health.



In this context, there is a number of studies investigating associations between MDP and specific mental disorders, mainly depressive symptoms and anxiety state, cognitive decline and outcomes related to physical disability were found. Some of them can be cited.

Georgousopoulou *et al.* (2014) investigated, the effect of the Mediterranean diet on non-fatal cardiovascular events, from a case-control study conducted with elderly in Greece considering their state of anxiety and depression. According to the results, greater adherence to the Mediterranean diet was associated with lower probability of nonfatal cardiovascular events, even after adjustment for anxiety or depression. After stratification of depression or anxiety, the Mediterranean diet remained a protective factor in people with low levels of depression and anxiety for the acute coronary syndrome (ACS).

A longitudinal study followed 6158 elderly people living in three neighborhoods in southern Chicago, identified in a census survey from 1993 to 1996. The group with the lowest adherence to the Mediterranean diet had higher rate of depressive symptoms ($p = 0.05$), whilst those with the highest adherence had a very low (close to zero) occurrence of depressive symptoms ($p < 0.001$). The rate of development of depressive symptoms per year was 98.6% lower among people with higher adherence compared to those who had lower adherence (Skarupski *et al.*, 2013).

Notara *et al.* (2016) investigated, in older adults and elderly people with ACS, the role of diet on depressive symptoms and on the incidence of CVD in 10 years (2004-2014). It was observed that individuals with greater adherence to the Mediterranean diet were less likely to present depressive symptoms ($p = 0.02$). The stratified analysis showed a statistically significant result of the adverse effect of depressive symptoms on the incidence of ACS, only among the patients with the highest score on the scale for depression and with low adherence to the Mediterranean diet ($OR=1,68$, $95\% IC=1.10-2.58$). Masana *et al.* (2018), using data from the MEDIS study, also evaluated the association between the Mediterranean diet and depression among older adults. This population-based, multi-national, cross-sectional study included 2718 older people from 22 Mediterranean islands. The results showed that higher adherence to this diet was associated with lesser identification of depressive symptoms.

A cross-sectional study (North American cohort - Osteoarthritis Initiative) evaluated the associations between adherence to the Mediterranean diet, quality of life, complaints of pain, stiffness, knee deficiency, and depressive symptoms in 4470 participants with a mean age of 61.3 years. The group with greater adherence to the Mediterranean diet had fewer fractures ($p = 0.004$) and less participants with diabetes ($p < 0.0001$). After adjustment for possible confounding factors, a higher MDS was associated with better quality of life related to fewer physical complaints ($p < 0.0001$), less pain and knees complain, and lower scores on the scale for depression ($p = 0.01$). Despite the limitations of the study, the authors suggested that greater adherence to the Mediterranean diet can be considered a good strategy to improve quality of life in Western countries with unhealthy food habits (Veronese *et al.*, 2016).

Hernandez-Galiot and Goni (2017) found, in a cross-sectional study conducted in a Mediterranean city of Spain, a positive association between adherence to the Mediterranean dietary pattern and cognitive function, but there was no clarity about the influence of healthy symptomatology of depression among elderly individuals aged 75 years and over. Trichopoulou *et al.* (2015) also noted that greater adherence to the Mediterranean dietary pattern is a protective factor against cognitive decline in older Mediterranean population. In this study, among the nine components of the Mediterranean dietary pattern, only vegetable consumption showed a significant inverse association with cognitive decline, considering its possible interaction with the other components of the diet.

A prospective cohort study with 1815 community-dwelling elderly (≥ 60 years old) in Spain showed that increasing adherence to the Mediterranean dietary pattern was associated with reduced risk of frailty with reduced risk of slowed walking speed ($OR\ 0,53$; $IC\ 95\%\ 0,35-0,79$) and weight loss ($OR\ 0,53$; $IC\ 95\%\ 0,36-0,80$). Finally, the risk of frailty was inversely

associated with fish (OR 0,66; IC 95%: 0,45-0,97) and fruits consumption (OR 0,59; IC 95%: 0,39-0,91) (Leon-Munoz *et al.*, 2014). A cross-sectional study, including 351 people older than 60 years from Spanish mediterranean areas, found that men with higher adherence to the mediterranean diet presented greater mental health and greater physical function; the same was not identified in women (Zaragoza-Martí *et al.*, 2017).

A mediterranean-style diet is also associated with sleep. Among older American adults, those with a moderate and high adherence to the Mediterranean diet reported longer sleep duration and fewer insomnia symptoms. Over 10 years, participants who maintained the score of adherence to this diet presented fewer insomnia symptoms when compared to those who reduced the adherence to the Mediterranean dietary pattern (Castro-Diehl *et al.*, 2018). Another study with Greek population aged ≥ 65 years (n=1639) found a positive association between sleep quality and the adherence to the mediterranean diet. No association was found regarding sleep duration (Mamalaki *et al.*, 2018).

Despite of the possible importance of MDP on brain health, there is not, as far as we know, studies evaluating the association between the adherence to this dietary pattern and the presence of CMD, which can include other brains disorders beyond depression and anxiety.

In addition, most of the identified studies were carried out with populations from Mediterranean regions. When assessing the adherence to the MDP in populations living in other regions, especially in western countries, it is important to consider the differences in the food cultural between these countries, related mainly to the type of preparation and degree of food processing (Hoffman and Gerber, 2015; Martínez-González *et al.*, 2017). In non-Mediterranean regions there is greater availability and consumption of food that does not characterize the Mediterranean diet, for example, alcoholic beverages in general and other vegetable oils replacing the olive oil (Vareiro *et al.*, 2009; Martínez-González *et al.*, 2017). In addition, foods submitted to industrial processes, such as addition of sodium, sugar, saturated and trans fat and other additives, are consumed in greater proportion (Slimani *et al.*, 2009; Moubarac *et al.*, 2017; Baker and Friel, 2014; Louzada *et al.*, 2015). The presence of these foods can be associated with reduction of benefits of the original MDP (Dhaka *et al.*, 2011; Rauber *et al.*, 2018; Quirk *et al.*, 2013).

2. PROBLEM STATEMENT AND JUSTIFICATION

Population aging generates social and economic consequences for many reasons, which includes an increase in chronic diseases that affect the health of the elderly. The presence of CMD has become more frequent in all population, reaching higher percentage of individuals with advancing age, generating losses in the state of health. Although CMD do not characterize a serious clinical condition, it generates psychological distress and functional incapacity for patients, and increase the risk of developing major disorders in the future. Thus, their early identification is essential to prevent more severe conditions.

The Mediterranean dietary pattern has been investigated as a factor that may help in the prevention or relief of mental health-related conditions. Studies involving this relation were carried out mainly with populations from Europe and a minority involving countries of North America, where the consumption of foods components with nutritional composition different from the Mediterranean diet is considerable. In Brazil, studies that investigate the Mediterranean dietary pattern in the elderly are still scarce. In addition, the association between diet and emotional health in the elderly is also poorly studied.

Therefore, considering the impact of TMC on the health of the elderly, studies that evaluate their association with the adherence to the Mediterranean dietary pattern are essential, not only to add results to the findings already disclosed by other countries, but also to conduct recommendations involving the components of this dietary pattern.

3. OBJECTIVES

3.1 GENERAL OBJECTIVE

To verify the association between adherence to the Mediterranean dietary pattern and Common mental disorders in the elderly living in São Paulo City, SP, Brazil.

3.2 SPECIFICS OBJECTIVES

- To identify the percentage of participants with CMD;
- To construct, characterize and evaluate the adherence to the MDP in the studied population considering two points of view: including only foods characteristic of this pattern and including foods characteristic of the western diet;
- To characterize the population of the study regarding demographic, socioeconomic, health status, lifestyle and anthropometric variables according to the presence of CMD and the adherence to the both MPD constructed;
- To verify if the level of adherence to the two proposed patterns is associated with the prevalence of CMD in the sample.

4. METHODS

The present study used data from a cross-sectional population-based survey, 2015 Health Survey of São Paulo (ISA-Capital 2015), presented below.

4.1 CONTEXT

The 2015 Health Survey of São Paulo (2015 ISA-Capital) was created through a partnership of the School of Public Health, University of São Paulo (FSP-USP) with the Municipal Health Secretariat, São Paulo (SMS-SP), in addition to the participation of researchers from other faculties of the University of São Paulo - USP, Paulista State University, State University of Campinas and the State Department of Health of São Paulo.

So far, the data were collected from the population of the city of São Paulo in the years of 2003, 2008 and 2015. The 2015 ISA-Capital, similar to previous surveys, collected data related to health status, lifestyle and use of health services of the resident population in the city of São Paulo, with the purpose of offering a database with all updated information.

The ISA-Capital 2015 data collection was performed through home interviews, from September / 2014 to December / 2015 by previously trained interviewers, through the application of a questionnaire composed of closed, semi-open and open questions, distributed in blocks (A to P) organized by thematic areas. This study will work with specific block data, including the thematic axis lifestyle that addressed issues and food surveys. These questions allowed to evaluate the food consumption of the participants, data belonging to the 2015 ISA - Nutrition, which will also be described below.

4.2 STUDY DESIGN

2015 ISA-Capital has a population-based cross-sectional design, through a household and telephone survey.

4.3. CASUISTIC AND DATA COLLECTION

4.3.1 2015 ISA-Capital

The study population refers to the population living in permanent private households in an urban area of the city of São Paulo during the period of the survey. The sample was representative for the geographic domains, for the five Regional Health Coordination of São Paulo city (north, mid-west, southeast, south and east), for age (12 to 19 years, 20 to 59 years and 60 years or older) and for both genders.

The sampling process was drawn in two stages. In the first stage, 30 urban census tracts were randomly selected from each Regional Health Coordination, totalizing 150 primary units of sampling in the municipality. In the second stage, an average of 18 households (the number corresponding to the highest family value, calculated considering each demographic domain used to plan the sample) was systematically selected in each sector. All individuals in the households that belonged to the demographic domain selected in the study were invited.

The objective was to obtain a final sample of 4250 participants (808 aged 12 to 19 years, 2462 aged 20 to 59 years and 980 aged ≥ 60 years), with 850 participants in each Regional Health Coordination.

To minimize the effects of losses and refusals to participate in subsequent phases, larger independent random selections were performed. Different sampling fractions were used to select the individuals belonging to the domains. In data analysis, sampling weights were used to deal with these differences. More details about 2015 ISA-Capital can be found in Alves *et al.* (2015).

4.3.2 2015 ISA-Nutrition

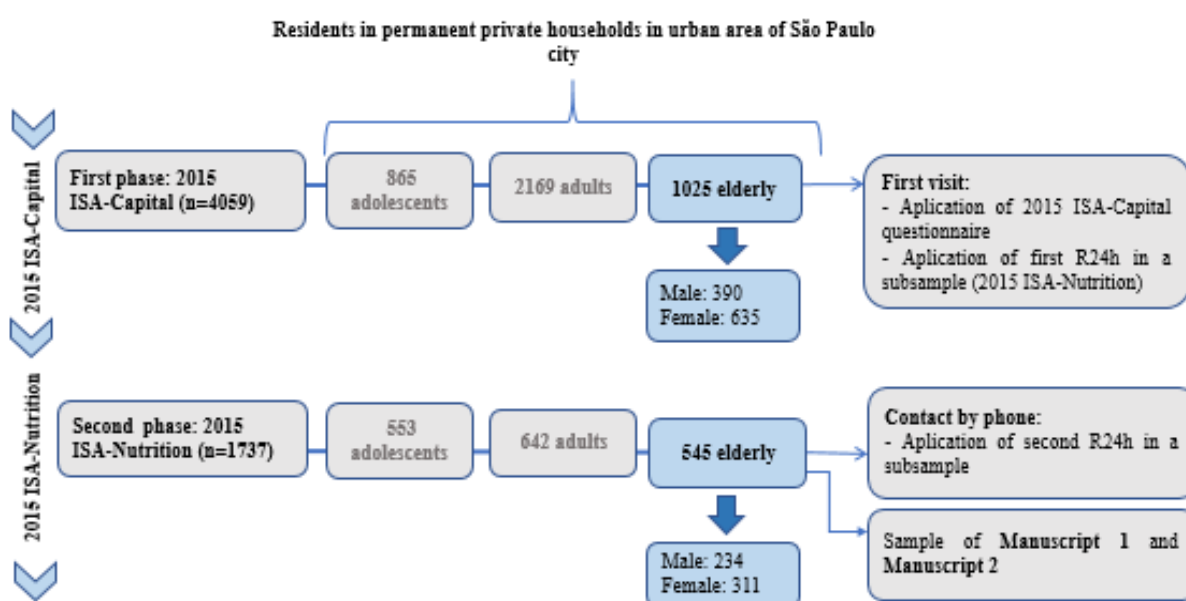
2015 ISA-Nutrition is a population-based household survey conducted from February 2015 to February 2016. This research consisted of a subsample of 2015 ISA-Capital, as a plan to include 300 participants in each demographic domain (12 to 19 years, 20 to 59 years and age ≥ 60 years), which allows the estimation of change / difference proportions of 0.50, with a sampling error of seven percentage points, considering a 95% confidence level and a delineation effect of 1.5.

Among the 4059 invited people who agreed to participate in 2015 ISA-Capital, 1737 individuals were randomly selected to participate in 2015 ISA-Nutrition, responding to the first 24-hour dietary recall (R24h) (APPENDIX 2). The second R24h were applied by phone in a subsample from this universe. Individuals who were on enteral and / or parenteral diet, have chronic alcoholism and pregnant / lactating women were excluded from 2015 ISA-Nutrition. More details about 2015 ISA-Nutrition can be found elsewhere (Fisberg *et al.*, 2018).

The sample of the present study included only individuals above 60 years old, of both genders, who participated in both phases of the research. A total of 545 elderly participants were randomly selected to be included in the 2015 ISA-Nutrition and therefore are part of the sample included in this research (Figure 2).

To respond the proposed objectives of this research, we elaborated two Manuscripts, which will be presented herein.

Figure 2. Flowchart of the 2015 ISA-Capital and 2015 ISA-Nutrition sample used in the first manuscript and second manuscript.



SOURCE: Adapted from Fisberg *et al.* (2018).

4.4. VARIABLES OF THE PRESENT STUDY

4.4.1 Evaluation of mental health through the identification of Common mental disorders (CMD)

The presence of CMD was defined using the SRQ-20 score, referring to Block E - Emotional Health (APPENDIX 3). The 20 questions that compound this instrument are closed, easy to apply, with possibilities of dichotomous responses (yes / no) and involve physical and psychic symptoms grouped in four domains: depressive-anxious mood, decrease in vital energy, somatic symptoms and depressive thoughts (Chart 1). In addition, all 20 questions were asked with reference to the 30 days preceding the interview.

According to a study by Scazufca *et al.* (2009) who examined the validity of SRQ-20 in a population of elderly participants, it was observed that the cut-off point 4/5, for the total score of questions, presented better sensitivity (76.1%) and specificity (74.6 %) for both genders. Other Brazilian studies performed with the elderly adopted the cut-off point of 5, suggested by Scazufca *et al.* (2009) (Coutinho *et al.*, 2014; Borim *et al.*, 2013; Pinto *et al.*, 2014). Thus, the cut-off point for TMC in this study was adopted as 5 for men and women aged 60 years or older.

Chart 1. SRQ-20 questions according to the type of disorder and symptom domain.

Type of disorder	Domain of symptoms	SRQ-20 questions
Anxiety-Related Disorders	Depressive-anxious mood	Do you feel nervous, tense or worried? Are you easily frightened? Do you feel unhappy? Do you cry more than usual?
Other neurotic disorders	Decrease in vital energy	Are you easily tired? Do you find it difficult to make decisions? Do you find it difficult to enjoy your daily activities? Is your daily work suffering? Do you feel tired all the time? Do you have trouble thinking clearly?
Somatoform disorders	Somatic symptoms	Do you often have headaches? Do you sleep badly? Do you have uncomfortable feelings in your stomach? Is your digestion poor? Is your appetite poor? Do your hands shake?
Depression	Depressive thoughts	Are you unable to play a useful part in life? Have you lost interest in things? Has the thought of ending your life been on your mind? Do you feel that you are a worthless person?

SOURCE: WHO, 1994 and Santos *et al.* (2009).

4.4.2 Dietary assessment

4.4.2.1. Obtaining and processing food data

Food consumption data were obtained by applying two non-consecutive R24H within one year, covering all days of the week and all the seasons. The application of this instrument made it possible to collect the data of all foods and beverages consumed by the participant the day before the interview. The first R24h was applied at the residence together with the other

ISA-Capital 2015 structured questionnaires. The interview was conducted by individuals trained and instructed to complete R24h based on the Multiple Pass Methods (MPM), a method developed by the United States Department of Agriculture (USDA) where the respondent is questioned in five successive steps as presented in Figure 3 (Moshfegh *et al.*, 2008):

Figure 3: 5-Step Multiple-Pass Method.

STEPS	PURPOSE
Step 1: Quick List	Collect a list of foods and beverages consumed the previous day
Step 2: Forgotten foods	Probe for foods forgotten during the Quick List
Step 3: Time & Occasion	Collect time and eating occasion for each food
Step 4: Detail cycle	For each food, collect detailed description, amount and additions. Review R24H.
Step 5: Final Probe	Final probe for anything else consumed

The MPM contributes to maintain the interviewee interested and remember all the foods and beverages consumed, reporting them in detail, which reduces errors in dietary measurement (Raper *et al.*, 2004). The second R24h was conducted through telephone interviews conducted by trained nutrition students, using the interview system incorporated in the Nutrition Data System for Research software (NDSR, version 2014, developed by the Center for Nutrition Coordination, University of Minnesota, Minneapolis, MN, United States of America). This software has as main database the US Food Composition Table developed by the USDA, (NCC, 2014).

In both collections, the interviewers were instructed to conduct a detailed description of all the foods and beverages in home measures and to question the preparation methods, ingredients and brands of food items. The food and preparations collected were quantified and standardized, which allowed the conversion of portion size into units of weight and volume (Fisberg and Villar, 2002; Pinheiro *et al.*, 2000), besides standardizing the data entry in the NDSR software. The energy and macronutrient nutritional values of all foods included in the 2015 ISA-Nutrition database were compared with those of the Brazilian table of food

composition (TACO, 2011) and corrected when required. The nutritional values of foods and regional preparations were estimated based on TACO (2011) (NEPA-UNICAMP, 2011).

Information about dietary supplement intake was also collected, with a description of details such as the brand or active ingredient and dosage of the medication they were using at that time (APPENDIX 4). For supplements described only by brand name, nutrient information was identified for further classification.

In order that the results obtained with the application of R24h may represent an estimate of habitual dietary intake, it was necessary to remove the intrapersonal variance of each food group. This process was performed using statistical modeling techniques embedded in the Multiple Source Method (MSM) software - an online platform that calculates the usual intake of nutrients and food consumed by the population based on data from two or more food surveys (Haubrock *et al.*, 2011).

4.4.2.2. Evaluation of the adherence to the Mediterranean dietary pattern

The Mediterranean dietary pattern adherence was assessed using the Mediterranean-diet Score (MDS), proposed by Trichopoulou *et al.* (2003). To obtain the MDS, individuals whose consumption of fish, vegetables, legumes, fruits and nuts, cereals and monounsaturated: saturated fat ratio was below or above the median of the own group, received the punctuation of “zero” and “one”, respectively. An inverse score was assigned for consumption of meat and dairy products, above or below the median. All the food ingested were adjusted for total energy intake by both genders. For alcohol, a value of one was assigned to a moderate consumption between men (10 and 50 g per day) and women (5 and 25 g per day) and zero for consumption below or above these values for each sex. Thus, the total MDS ranged from 0 to 9, with higher scores indicating greater adherence to the Mediterranean diet pattern. To perform the analyses, the MDS was classified in low adherence (0-3), moderate adherence (4-5) and high adherence (6-9). Chart 2 contains the description for assigning the scores, as described above.

Following the methods mentioned above, the MDS was calculated considering two possible views of this dietary pattern: Mediterranean pattern origin-like (MPOL), which included only the original foods of the Mediterranean diet, maintaining as much as possible the statement of being fresh, locally produced and not modified or with minimal modifications from their natural state; and Mediterranean pattern with non-Mediterranean procedures (MPNM), which included foods with non-Mediterranean characteristics or submitted to

procedures that diverge from the original dietary pattern (alcoholic beverages other than red wine, several sources of monounsaturated and foods with industrial addition of sugar, salt and chemical additives). The inclusion of foods to construct each pattern was based on the propose described by Martínez-González et al. (2017). A detailed description of the foods included in these two patterns was presented in Manuscript 1.

Chart 2. Proposal to obtain the Mediterranean dietary score.

Classification	Food Component	Cut-off point	Value
Established as beneficial	Vegetables	Consumption (g / day) above median specific for sex	1
	Legumes		
	Fruits and nuts		
	Cereals	Consumption (g / day) below median specific for sex	0
	Fish		
	Monounsaturated:saturated lipids (ratio)		
Established as harmful	Alcohol	Men: intake ≥ 10 to ≤ 50 g / d	1
		Women: intake ≥ 5 to ≤ 25 g / d	
		Men: <10 ou > 50 g / dia	0
	Meat	Women: <5 ou > 25 g / dia	
		Consumption (g / day) below median specific for sex	1
		Consumption (g / day) above median specific for sex	0
	Dairy	Consumption (g / day) below median specific for sex	1
		Consumption (g / day) above median specific for sex	0

SOURCE: Trichopoulou *et al.* (1995) e Trichopoulou *et al.* (2003).

4.4.3 Demographic variables:

- Gender: Male; female
- Age: ≤ 70 years; > 70 years
- Marital status: with partner; without partner.

4.4.4 Socioeconomic variables:

- Formal education: ≤ 9 years; 10-12 years; > 12 years
- Per capita household income: ≤ 1 Minimum wage; > 1 Minimum wage and < 3 Minimum wage; > 3 Minimum wage. Minimum wage value in 2015: 224.02 USD.

4.4.5 Lifestyle variables:

- Physical activity: Complies with the recommendation (≥ 150 minutes/week); Does not comply with the recommendation (< 150 minutes/week).

Information of the physical activity level was obtained using the International Physical Activity Questionnaire (IPAQ) - long version, previously validated in Brazil (Matsudo et al., 2001). This variable was categorized according to the recommendation of the World Health Organization (WHO, 2011).

- Smoking status: Never smoked; Former smoker; Current smoker

4.4.6 Anthropometric variable:

- Body Mass Index (BMI): Below normality range - $< 23 \text{ kg/m}^2$; Normality range - 23 to 28 kg/m^2 ; Overweight - 28 to 30 kg/m^2 ; Obese - $> 30 \text{ kg/m}^2$ (PAHO, 2002)

4.4.7 Health status

- Number of referred chronic diseases: 0; ≥ 1 . Included the following: Diabetes mellitus; High blood pressure; Dyslipidemia; Rheumatic diseases; Cerebrovascular accident

4.5 DATA ANALYSES

Logistic regression models were used to evaluate the association between the adherence to both dietary patterns and CMD. Each manuscript presents a detailed description of the analyzes used.

A significance level of 5% ($p < 0.05$) was considered for final statistical tests. All data analyses were performed using Stata software (version 14).

4.6. ORGANIZATION OF STUDY VARIABLES

4.6.1 Dependent variable

Mental Health:

- Common Mental Disorders, identified by means of the total score obtained in SRQ-20

4.6.2 Independent variables

➤ Variable of interest

- Adherence to the MPOL and to the MPNM: obtained through the MDS,

➤ Control variable

- Variables described in items 4.4.3 to 4.4.7.

The chart below (Chart 3) describes the types of variables to be inserted into the regression models.

Chart 3. Description of variables included in the study.

Group of the variable	Variable	Variable classification	Number of categories (description)
<i>Dependent variable (Second Manuscript)</i>			
Mental Health	CMD ¹ (score SRQ-20)	Categorical	2-yes/no
<i>Independent variable</i>			
<i>Variable of interest (First Manuscript and Second Manuscript)</i>			
Adherence to the MPOL³ and to the MPNM⁴	MDS ²	Categorical	3-Low/ Moderate/ High
<i>Control variable (Manuscript 1 and Manuscript 2)</i>			
Demographic	Gender	Categorical	2-Male/Female
	Age		2- ≤70/>70
	Marital status		2-Without a partner/with a partner
Socioeconomic	Years of Formal education		3- ≤ 9 years/10-12 years />12 years
	Per capita household income (per month)		3- ≤ 1 MW ⁵ / > 1 MW ⁵ and < 3 MW ⁵ / > 3 MW ⁵
Lifestyle	Physical activity ⁶		2-Complied with the recommendation / Did not comply with the recommendation
	Smoking status		3 - Never smoked; Former smoker; Current smoker
Anthropometric	BMI ⁷		4 - Below normality range/ Normality range/ Overweight/ Obese
Health status	Number of referred chronic diseases: - Cerebrovascular accident - Diabetes mellitus - High blood pressure		2 - 0/≥1

	- Dyslipidemia - Rheumatic diseases		
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¹CMD: Common mental disorders; ²MDS: Mediterranean diet score; ³MPOL: Mediterranean pattern origin-like (included only the original foods of the Mediterranean diet, wine for alcohol and olive oil for monounsaturated lipid); ⁴MPNM: Mediterranean pattern including non-Mediterranean foods included foods or submitted to procedures that diverge from the original dietary pattern (included alcoholic beverages other than red wine, several sources of monounsaturated and foods with industrial addition of sugar, salt and chemical additives). ⁵MW: Minimum wage value in 2015 was 224.02 USD; ⁶WHO (2011) recommendation; ⁷BMI: Body Mass Index (Below normality range: <23kg/m²; Normality range: 23 to 28kg/m²; Overweight: 28 to 30kg/m²; Obese: >30kg/m²).

4.7 ETHICS ASPECTS

The present study used data from research (2015 ISA-Capital and 2015 ISA-Nutrition) previously approved by the Research Ethics Committee of the Faculty of Public Health of the University of São Paulo, protocols n° 32344014.3.3001.0086 and 30848914.7.0000.5421. All participants randomly selected and included in the study accepted to participate voluntarily, after knowing the objectives of the study, the type of information that would be collected and the signing of the Informed Consent Term (APPENDIX 5). The confidentiality of the information collected was ensured, and only consolidated data were analyzed and disseminated, making it impossible to identify the participants.

5. RESULTS AND DISCUSSION

5.1 FIRST MANUSCRIPT

Adherence to the Mediterranean dietary pattern by community-dwelling elders from São Paulo, SP, Brazil

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Abstract

The benefits of the Mediterranean dietary pattern (MDP) on general health are frequently mentioned in the literature. Nevertheless, investigations about the adherence to MDP by Brazilian population are still scarce, especially regarding old-age persons. This study aims to: (i) describe the degree of adherence to this dietary pattern by Brazilian elders; (ii) to identify modifications made by the elders, in the form of intake of the different components of the original MDP. We analyzed data from 545 elders extracted from 2015 database of Health Survey of São Paulo, Brazil, a population-based cross-sectional study. The adherence to MDP was determined using Mediterranean Diet Score (MDS), obtained from two 24h food records. Two possible views of this dietary pattern were considered: Mediterranean pattern origin-like (MPOL), which included only the original components of the Mediterranean diet, maintaining their original form (fresh, locally produced and not modified, or with minimal modifications from their natural state); and Mediterranean pattern with non-Mediterranean procedures (MPNM), which included foods with non-Mediterranean characteristics or submitted to procedures that diverge from the original dietary pattern (alcoholic beverages other than red wine, several sources of monounsaturated and foods with industrial addition of sugar, salt and chemical additives). Our results showed a moderate adherence to the both MDP views by the Brazilian elders from Sao Paulo, SP. Moreover, higher adherence to the both dietary pattern proposed was characterized by a greater intake of almost all foods components presumed as beneficial (vegetables, fruits, nuts, cereals, monounsaturated:saturated lipids ratio and legumes) and lower consumption of those presumed as harmful (meat and dairy products). The inclusion

of foods that are not characteristics of the Mediterranean diet overestimated the adherence to this dietary pattern, increasing the number of participants with high adherence.

Keywords: Aged, Mediterranean diet, Mediterranean dietary pattern.

1. Introduction

The current global scenario has been facing perceptible changes in its demographic profile. One of the most notable changes is the acceleration of population aging, especially in developing regions (United Nations, 2013; United Nations, 2015). Considering several social, biological and psychological factors related to the aging process, elder people become more susceptible to the development of chronic diseases (Michaud et al., 2013; Dziechciaż & Filip, 2014; King & Lipsky, 2015). Importantly, throughout life, some of these diseases can be prevented by a healthy lifestyle, which includes food habits (Jacobs, Gross & Tapsell, 2009).

There is a number of published studies exploring the relationship between diet and chronic diseases. Among these studies, the investigation of Mediterranean dietary pattern (MDP) deserve special importance (Bonaccio et al., 2018; Nowson, Service, Appleton, & Grieger, 2018). Traditionally, the MDP is high in vegetables, legumes, fruits, nuts and cereals (mainly unrefined); moderate to high in fish and olive oil; moderate in fermented dairy products, specially cheese and yogurt; low in red meat and derivatives; moderate in alcohol, particularly in wine (Willett et al., 1995). In terms of nutrients, this food pattern is featured by an elevated ratio between monounsaturated to saturated fat; high in fiber and in different types of phytochemicals (Willett et al., 1995; Davis, Bryan, Hodgson, & Murphy, 2015). Furthermore, the MDP is characterized by the consumption of fresh, locally produced and not modified or with minimal modifications from their natural state (Martinez-Gonzalez, Hershey, Zazpe, & Trichopoulou, 2017; Hachem et al., 2016).

Systematic reviews and meta-analyses have proven benefits of MDP on the development of different chronic diseases related to aging (Dinu, Pagliai, Casini, & Sofi, 2018; Koloveryou, Esposito, Giugliano, & Panagiotakos, 2014; Forsyth et al., 2018; Sofi, Abbate, Gensini, & Casini, 2010). However, the majority of the studies were performed in the Mediterranean area. Studies investigating MDP in other non-Mediterranean places, have not always shown the same results (Koyama et al., 2015; Tsivgoulis et al., 2013; Skarupski, Tangney, Li, Evans, & Morris, 2013; Veronese et al., 2016; Mattei, Sotos-Prieto, Bigornia, Noel, & Tucker, 2017). The

adherence of MDP by non-Mediterranean populations has shown the influence of cultural aspects, such as the inclusion of foods that, although can be generically included in the same MDP components, are modified in terms of home preparation and/or industrial processing. These modifications can lead to higher intake of sodium, refined carbohydrates, saturated or trans fats, inclusion of different food additives, as well as reduction of dietary fibers (Slimani et al., 2009; Moubarac, Batal, Louzada, Martinez Steele, & Monteiro, 2017; Baker & Friel, 2014). Moreover, in non-Mediterranean areas, olive oil is frequently replaced for other types of oils and, instead of red wine, these populations use to drink a broad variety of alcoholic drinks (Vareiro et al., 2009; Martínez-González et al., 2017). Therefore, these variations of MDP certainly must be taken into account before investigating associations between this pattern and health outcomes in populations from different countries.

As such, the present study intends to put together the following points: (a) the population aging, especially in Brazil, increases the burden of chronic diseases; (b) considering the well-known benefits of MDP in attenuating the risk of developing chronic diseases, the investigation of the adherence to this dietary pattern by elders is an important public health aspect; (c) the investigation of this adherence should differentiate the inclusion of non-Mediterranean modifications in the food intake. As far as we know, there is not any published study investigating these questions in Brazil. The aim of this study was to evaluate and explore the degree of adherence to the MDP by Brazilian elders, and to differentiate the non-Mediterranean modifications in the identified food intake.

2. Methods

Study sample

This study includes data from a population-based cross-sectional study from São Paulo State, Brazil, carried out since 2001, with the aim to evaluate the health status of the population, and different associated factors. The editions of this study carried specifically in São Paulo City, SP, Brazil (ISA-Capital), were performed in 2003, 2008 and 2015 (Alves et al., 2018), and the present study included only the data of the 2015. People residing in permanent private households in the urban area of São Paulo city were randomly selected, from September 2014 to December 2015.

The sample was stratified by clusters, which was performed in two stages: census tracts, stratified in five Regional Health Coordination of São Paulo city (north, mid-west, southeast, south and east) and domiciles. In the first stage, 30 census tracts of each coordination were

randomly selected, totalizing 150 primary units of sampling in the municipality. In the second stage of each census tract, an average of 18 households was systematically selected. All the persons from the families who belonged to the demographic domain selected in the study and who met the inclusion criteria (people of both genders, aged 12+ years and residing in the urban area of São Paulo during the period of the survey) were interviewed. The exclusion criteria were: individuals with chronic alcoholism, those on an enteral and / or parenteral diet, and pregnant or lactating.

In order to minimize the effects of losses and refusals, larger independent random selections were performed, securing a sample that allowed the estimation of proportions of the differences of 0.50. The sampling error was seven percentage points, considering a 95% confidence level and a delineation effect of 1.5.

Among the 4059 invited people who agreed to participate 2015 ISA-Capital, 1737 were randomly selected to participate in the first phase of 2015 ISA-Nutrition, a study which included nutritional data. More details about 2015 ISA-Capital and 2015 ISA-Nutrition were previously published (Alves et al., 2018; Fisberg et al., 2018).

The analyses of the present study included only data from elderly (age ≥ 60 years) of both genders, who also had their food consumption data collected in 2015 ISA-Nutrition. A total of 545 individuals were randomly selected to participate in 2015 ISA-Nutrition, responding the first 24-hour dietary recall (R24H) and therefore composing the sample of this study.

The 2015 ISA-Capital and 2015 ISA-Nutrition were approved by the Research Ethics Committee of the Faculty of Public Health of the University of São Paulo, protocols 32344014.3.3001.0086 and 30848914.7.0000.5421, respectively. All individuals included in the survey had their data collected only after signing the Informed Consent Form.

Dietary Assessment

Food consumption data were obtained by applying two non-consecutive R24H within one year, covering all days of the week and all the seasons. The first R24h was applied during a first domicile visit and was completed based on the Multiple Pass Methods (MPM), developed by the US Department of Agriculture (USDA), with the aim of reducing errors in the dietary measurement (Raper, Perloff, Ingwersen, Steinfeldt, & Anand, 2004). The second R24h was applied through telephone calls using the interview system incorporated into the Nutrition Data System for Research (NDSR, version 2014, developed by the Nutrition Coordination Center, University of Minnesota, Minneapolis, MN, USA United States of America). This software has

as main database the US Food Composition Table developed by the USDA. All data were entered in the NDSR software (version 2014). Furthermore, regarding all the food included in the ISA-Nutrition 2015 database, their nutritional values of energy and macronutrients were compared with values from a food composition of a Brazilian table of food composition (TACO, 2011) and corrected when required. Subsequently, habitual dietary intake was obtained using the Multiple Source Method (MSM), a statistical method which estimates the usual intake of food and nutrients consumed by the population identified in the two R24Hs (Haubrock et al., 2011).

Adherence to the Mediterranean dietary pattern

The Mediterranean dietary pattern adherence was assessed using the Mediterranean-diet Score (MDS), proposed by Trichopoulou et al. (2003). To obtain the MDS, individuals whose consumption of fish, vegetables, legumes, fruits and nuts, cereals and monounsaturated: saturated fat ratio was below or above the median of the own group, received the punctuation of “zero” and “one”, respectively. An inverse score was assigned for consumption of meat and dairy products, above or below the median. All the food ingested were adjusted for total energy intake by both genders. For ethanol, a value of one was assigned to a moderate consumption between men (10 and 50 g per day) and women (5 and 25 g per day) and zero for consumption below or above these values for each sex. Thus, the total MDS ranged from 0 to 9, with higher scores indicating greater adherence to the Mediterranean diet pattern. To perform the analyses, the MDS was classified in low adherence (0-3), moderate adherence (4-5) and high adherence (6-9).

Following the methods mentioned above, the MDS was calculated considering two possible views of this dietary pattern: Mediterranean pattern origin-like (MPOL), which included only the original foods of the Mediterranean diet, maintaining as much as possible the statement of being fresh, locally produced and not modified or with minimal modifications from their natural state; and Mediterranean pattern with non-Mediterranean procedures (MPNM), which included foods with non-Mediterranean characteristics or submitted to procedures that diverge from the original dietary pattern (alcoholic beverages other than red wine, several sources of monounsaturated and foods with industrial addition of sugar, salt and chemical additives). The inclusion of foods to construct each pattern was based on the proposed by Martínez-González et al. (2017), as presented in Table 1.

Table 1. Foods and type of lipids included in both the MDP.

MDP ¹ components	MPOL ²	MPNM ³
Vegetables	Fresh vegetables	Fresh vegetables and preserved or canned vegetables
Fruits and nuts	Fresh fruits, fresh fruit juices unsweetened, unsweetened dehydrated fruit, fresh nuts, roasted or dried unsweetened and unsalted	Fresh fruits, fresh fruit juices unsweetened, fresh nuts, nectar, sweetened fruit drinks, sweetened, preserved or candied fruits, salted or sweetened nuts
Legumes	Dried legumes	Dried legumes and preserved legumes
Fish	Fresh or frozen fish	Fresh or frozen fish and canned fish
Alcohol	Red wine	Red wine, beer, rum, vodka, brandy, liquor, white wine or sparkling wine
Cereals	Whole cereals, whole grains, Whole bread, pasta, rice and flour	Whole cereals, whole grains, Whole bread, pasta, rice and flour White refined flour, bread, pasta and rice, refined and industrialized cereals, crackers, cookies and cakes
Meat	Fresh or frozen beef, pork and poultry	Fresh or frozen or processed beef, pork and poultry
Dairy	Milk, fresh or cured cheeses, natural yogurt	Milk, fresh or cured or processed cheeses, natural or sweetened or colored and/or flavored yogurt
Monounsaturated lipid	Monounsaturated fat, mainly from olive oil	Monounsaturated fat from olive oil and other foods sources
Saturated lipid	Saturated fat from all food sources	Saturated fat from all food sources

¹MDP: Mediterranean dietary pattern; ²MPOL: Mediterranean pattern origin-like (included only the original foods of the Mediterranean diet, wine for alcohol and olive oil for monounsaturated lipid); ³MPNM: Mediterranean pattern including non-Mediterranean foods or submitted to procedures that diverge from the original dietary pattern (included alcoholic beverages other than red wine, several sources of monounsaturated and foods with industrial addition of sugar, salt and chemical additives).

Covariates

2015 ISA-Capital data were obtained through the application of a structured questionnaire, organized by thematic areas. In the present study, sociodemographic variables (gender: male and female; age: ≤ 70 years and > 70 years; marital status: with partner and without partner; years of formal education: ≤ 9 years, 10-12 years, > 12 years and *per capita* household income: ≤ 1 minimum wage, > 1 and < 3 minimum wage, > 3 minimum wage), lifestyle (physical activity and smoking status - never smoked, former smoker, current smoker), anthropometric variable (Body Mass Index - BMI) and health status (number of referred chronic

diseases: 0 and ≥ 1 , including diabetes mellitus, high blood pressure, dyslipidemia, arthritis or arthrosis or rheumatism and cerebrovascular accident) were used.

The physical activity level was determined from the International Physical Activity Questionnaire (IPAQ) - long version, previously validated in Brazil (Matsudo et al., 2001). This variable was categorized as follows: do not comply with recommendation (<150 minutes/week) and comply with recommendation (≥ 150 minutes/week). These recommendations are in accordance with the World Health Organization – WHO (WHO, 2011). The BMI was calculated by dividing the weight (kg) by the squared height (m^2), self-reported measures, and classified according to Pan American Health Organization (PAHO, 2002) (below normality range: $\leq 23 kg/m^2$; normality range: >23 and $<28 kg/m^2$; overweight: ≥ 28 and $<30 kg/m^2$; obese: $\geq 30 kg/m^2$). The presence or absence of chronic diseases was also self-reported when asked if a doctor had already confirmed the presence of a certain disease.

Data Analyses

Categorical variables, covariates and level of intake of each food component by participants (who consumed above or below the median) were described by percentage of absolute frequency, giving the three degree of adherence (low, moderate and high) to the both pattern (MPOL and MPNM). Fisher's exact test was used to compare adherence to the Mediterranean dietary pattern according to sociodemographic, lifestyle, anthropometric and health status variables.

The intake of food components (continuous variables) in each dietary pattern was described by median. The normality was investigated using the Kolmogorov-Smirnov test. The medians of the daily consumption of each component among the genders were compared with the Mann-Whitney test.

All the statistical tests were two-tailed, considering a p-value <0.05 as significant. The analyses were undertaken in Stata software (version 14) considering the sampling weight.

3. Results

Table 2 depicts the socio-demographic aspects of the participants. The sample consisted mainly by women (44.7%), aged less than or equal to 70 years (62.1%), living with a partner (53%), with formal education lesser than 9 years (66%) and *per capita* household income between 1 and 3 minimum wages (47.1%). According to lifestyle, anthropometric and health status variables, there was a higher proportion of participants who did not comply with physical

activities recommendation (84.7%), never smoked (61.8%), had normal body weight (44.5%) and showed one or more chronic diseases (76.9%).

The participants presented a moderate adherence to both patterns, with a score of 4.01 ± 0.77 and 4.3 ± 0.82 in the MPOL and MPNM, respectively. The adherence to MDP was significantly associated with the educational level ($p = 0.027$) in the MPOL and with age in the MPNM ($p = 0.009$).

Table 2. Adherence to the Mediterranean dietary patterns according to sociodemographic, lifestyle, anthropometric and health status variables. São Paulo, Brazil, 2015.

Mediterranean diet score										

<i>Anthropometric</i>								
BMI (kg/m²)⁵						0.264		0.905
Below normality range	103	18.6	38	52	13	26	54	23
Within the normality range	228	44.5	89	99	40	67	113	48
Overweight	69	13.7	33	27	9	22	34	13
Obese	129	23.2	43	70	16	41	66	22
<i>Health status</i>								
Number of referred chronic diseases						0.779		0.291
0	126	23.1	46	62	18	30	72	24
≥1	394	76.9	152	179	63	118	194	82

¹Fisher's exact test was used to compare the categories of the variables in each MDP; ²MPOL: Mediterranean pattern origin-like (included only the original foods of the Mediterranean diet, wine for alcohol and olive oil for monounsaturated lipid); ³MPNM: Mediterranean pattern including non-Mediterranean or submitted to procedures that diverge from the original dietary pattern (included alcoholic beverages other than red wine, several sources of monounsaturated and foods with industrial addition of sugar, salt and chemical additives); ⁴MW: Minimum wage value in 2015 was 224.02 USD; ⁵BMI: Body Mass Index (Below normality range: <23kg/m²; Normality range: 23 to 28kg/m²; Overweight: 28 to 30kg/m²; Obese: >30kg/m²).

Table 3 shows the consumption of the nine food components of the MDP proposed in the present study, comparing between men and women, and between the possible views of this dietary pattern. Additionally, Table 3 depicts results of another study, which described the original MDP by elders from Greece (Trichopoulou et al, 2015). The daily intake of almost the totality of the food components in the MPOL was higher among women (except for legumes), with a statistically significant difference for vegetables ($p < 0.001$), fruits and nuts ($p = 0.006$), legumes ($p < 0.001$), cereals ($p < 0.001$), dairy products ($p < 0.001$), monounsaturated fat ($p < 0.001$), saturated fat ($p = 0.016$) and monounsaturated saturated fat ratio ($p < 0.001$). In the MPNM, women presented higher consumption of vegetables ($p < 0.001$), fruits and nuts ($p = 0.004$), fish ($p < 0.001$), dairy products ($p < 0.001$) and saturated fat ($p < 0.001$), while men consumed more legumes ($p < 0.001$).

Between the MPOL and the MPNM, there was a significant difference in the consumption of fish ($p < 0.001$), cereals ($p < 0.001$), alcohol ($p < 0.001$) and meat ($p = 0.001$) among men; among the women, there was significant difference in the consumption of fruits and nuts ($p = 0.0446$), fish ($p = 0.001$), alcohol ($p < 0.001$), cereals ($p < 0.001$), meat ($p = 0.013$) and dairy products ($p = 0.041$). In addition, confronted with the median daily intake of elders living in Greece, the participants of the present study presented numerically lower intake of vegetables, fruits and nuts, fish, alcohol, cereals, monounsaturated and saturated fat. Still, Brazilian elders presented lower monounsaturated to saturated fat ratio and a higher intake of legumes, meat and dairy products. Considering the MPNM, there was also a lower consumption of vegetables, fruits and nuts (only among men), fish, monounsaturated and saturated fat, lower

monounsaturated and saturated fat ratio and higher intake of legumes, alcohol, cereals, meat and dairy products.

Table 3. Median daily intake of the nine dietary components of Mediterranean diet score by sex. São Paulo, Brazil, 2015.

Food component ⁴	MPOL ¹		MPNM ²		Mediterranean population ³	
	Men	Women	Men	Women	Men	Women
Vegetables (g)	62.72*	74.39*	63.22 ^{&}	77.21 ^{&}	224	257
Fruits and nuts (g)	113.56*	128.12* [#]	117.76 ^{&}	141.61 ^{&#}	141.6	140.8
Legumes (g)	63.48*	46.08*	64.29 ^{&}	50.95 ^{&}	4.2	3.5
Fish (g)	3.74 ⁺	4.55 [#]	2.50 ^{&+}	3.51 ^{&#}	9.12	11.45
Alcohol (g)	0.69 ⁺	0.72 [#]	7.35 ⁺	5.70 [#]	3.36	0.65
Cereals (g)	27* ⁺	39.30* [#]	191.29 ⁺	193.89 [#]	69.2	63.5
Meat (g)	65.14 ⁺	66.33	76.69 ⁺	73.67	37.76	33.9
Dairy (g)	96.52*	119.32* [#]	103.08 ^{&}	130.82 ^{&#}	82	91.6
Monounsaturated lipid (g)	0.52* ⁺	0.77* [#]	11.68 ⁺	11.97 [#]	21.64	22.65
Saturated lipid (g)	11.08*	11.42*	11.08 ^{&}	11.42 ^{&}	11.48	11.55
Monounsaturated:saturated lipids (ratio)	0.05* ⁺	0.07* [#]	1.08 ⁺	1.04 [#]	1.89	1.96

¹MPOL: Mediterranean pattern origin-like (included only the original foods of the Mediterranean diet, wine for alcohol and olive oil for monounsaturated lipid); ²MPNM: Mediterranean pattern including non-Mediterranean or submitted to procedures that diverge from the original dietary pattern (included alcoholic beverages other than red wine, several sources of monounsaturated and foods with industrial addition of sugar, salt and chemical additives); ³Median adjusted to 1000kcal considering the results presented by Trichopoulou et al. (2015); ⁴Medians adjusted to 1000kcal. Mann-Whitney test: Energy intake among men (1638 kcal) and women (1396.3 kcal) was significantly different (p <0.001); * Mann-Whitney test: Statistically significant difference (p <0.05) between man and woman in MPOL; [&] Mann-Whitney test: Statistically significant difference (p <0.05) between men and women in MPNM; ⁺ Mann-Whitney test: Statistically significant difference (p <0.05) among men (MPOL and MPNM); [#] Mann-Whitney test: Statistically significant difference (p <0.05) among women (MPOL and MPNM).

Table 4 describes the level of intake (low, moderate or high) of each component of MDP, according to both views of this dietary pattern. Confronting the higher and the lower adherence to both MPOL and MPNM, we observe the majority of the participants with an intake above the median for vegetables (90.2% and 73.2% respectively), fruits and nuts (84.2% and 64.5%), legumes (70.2% and 81%), fish (85.2% and 68.3%), cereals (75.3% e 80.8%), greater monounsaturated and saturated lipids ratio (85.9% and 81%) and a lower intake of meat (79.3% and 71.6%) and dairy products (71.6% and 72.8%). However, alcohol was moderately consumed by a lower percentage of participants in the three degrees of adherence to both patterns.

When comparing the two views of patterns, it was also possible to observe that the frequencies of the different levels of consumption clearly changed, increasing for both, beneficial and harmful foods components. These information are detailed in Table 4.

Table 4. Description of the level of intake (low, moderate or high) of each component of MDP, in both views of this dietary pattern. São Paulo, Brazil, 2015.

Food component	Mediterranean Diet Score					
	MPOL			MPNM		
	Low (0-3) (n=210)	Moderate (4-5) (n=254)	High (6-9) (n=81)	Low (0-3) (n=158)	Moderate (4-5) (n=278)	High (6-9) (n=109)
Vegetables						
> median	37 (18.9%)	145 (60.6%)	73 (90.2%)	42 (29.3%)	134 (47.6%)	81 (73.2%)
< median	173 (81.1%)	109 (39.4%)	8 (9.8%)	116 (70.7%)	144 (52.4%)	28 (26.8%)
Fruits and nuts						
> median	53 (28.3%)	141 (55.9%)	65 (84.2%)	59 (38.4%)	137 (49.4%)	65 (64.5%)
< median	157 (71.7%)	113 (44.1%)	16 (15.8%)	99 (61.6%)	141 (50.6%)	44 (35.5%)
Legumes						
> median	92 (41.6%)	132 (50.3%)	59 (70.2%)	43 (27%)	147 (50.3%)	88 (81%)
< median	118 (58.4%)	122 (49.7%)	22 (29.8%)	115 (73%)	131 (49.7%)	21 (19%)
Fish						
> median	60 (29.8%)	141 (53.5%)	68 (85.2%)	51 (34.2%)	147 (51.9%)	77 (68.3%)
< median	150 (70.2%)	113 (46.5%)	13 (14.8%)	107 (65.8%)	131 (48.1%)	32 (31.7%)
Alcohol³						
Moderate	0 (0%)	4 (2.2%)	2 (3.3%)	20 (13.1%)	84 (31.4%)	54 (49.1%)
Low or high	210 (100%)	250 (97.8%)	79 (96.7%)	138 (86.9%)	194 (68.2%)	55 (50.9%)
Cereals						
> median	58 (28%)	145 (58%)	58 (75.3%)	43 (25.4%)	153 (51.8%)	90 (80.8%)
< median	152 (72%)	109 (42%)	23 (24.7%)	115 (74.6%)	125 (48.2%)	19 (19.2%)
Meat						
> median	143 (66.4%)	119 (52.3%)	16 (20.7%)	111 (67.9%)	144 (51%)	35 (28.4%)
< median	67 (33.6%)	135 (47.7%)	65 (79.3%)	47 (32.1%)	134 (49%)	74 (71.6%)
Dairy						
> median	129 (61.1%)	126 (49.1%)	24 (28.4%)	116 (69.8%)	135 (48.2%)	30 (27.2%)
< median	81 (38.9%)	128 (50.9%)	57 (71.6%)	42 (30.2%)	143 (51.8%)	79 (72.8%)
Monounsaturated:saturated lipids (ratio)						
> median	50 (21.8%)	153 (60.1%)	69 (85.9%)	30 (16.5%)	159 (57.2%)	92 (81%)
< median	160 (78.2%)	101 (39.9%)	12 (14.1%)	128 (83.5%)	119 (42.8%)	17 (19%)

¹MPOL: Mediterranean pattern origin-like (included only the original foods of the Mediterranean diet, wine for alcohol and olive oil for monounsaturated lipid); ²MPNM: Mediterranean pattern including non-Mediterranean foods or submitted to procedures that diverge from the original dietary pattern (included alcoholic beverages other than red wine, several sources of monounsaturated and foods with industrial addition of sugar, salt and chemical additives); ³**Low:** < 10g/day for men and < 5g/day for women; **moderate:** 10 a 50g/day for men and 5 a 25g/day for women; **high:** > 50g/day for men e > 25g/day for women.

4. Discussion

The participants of the present study showed, in general, a moderate adherence to the MDP, which was significantly associated with formal education (in MPOL view) and age (in MPNM view). Even though there was no significant association between the adherence to the MDP and gender, women in general reported a higher intake of almost all components. The MNPN view, which took into account the inclusion of foods with different characteristics from the original Mediterranean diet, resulted in higher consumption of almost all food components; fruits and nuts, dairy (by women), fish, alcohol, cereals, monounsaturated fat, meat (by men). In turn, when confronting our views of MDP with the intake of a Mediterranean population from Greece (which we considered as reference), the intake of legumes (beneficial), meat and dairy (harmful in excess), were higher in MPOL. Furthermore, in the MPNM, the consumption of cereals and alcohol showed to be higher than the reference.

Studies involving Mediterranean populations showed that the higher education level was significantly associated with MDP adherence (Hu et al., 2013; Ntanasi et al., 2018). These results agree with statements that a higher educational level increases the probability of choosing healthier food (Lê et al., 2013; Moreira & Padrao, 2004). In addition, the significant association with age found in our sample is in agreement with some studies performed in non-Mediterranean regions (Tsivgoulis et al., 2013; Veronese et al., 2018).

The degree of MDP adherence found in our work is consistent with previous publications performed with non-Mediterranean populations, showing this adherence to be low. Our average MDS showed to be quite similar to studies with Puerto Rican living in Boston, Massachusetts (4.37) (Ye et al., 2013) and population from New York, USA (4.36) (Scarmeas et al., 2009). A multicenter prospective cohort including nine European countries, with populations aged 60+ years old, presented similar results in relation to the degree of adherence to the MDP. The mean of the MDS in countries not bordering the Mediterranean Sea ranged from 2.92 (The Netherlands) to 4.73 (United Kingdom), while in France, Italy, Spain and Greece, the mean scores were 5.01, 5.34, 5.61 and 6.25, respectively (Trichopoulou et al., 2005). Important to notice that those studies adopted as reference a modification of the original MDS (Trichopoulou et al., 1995; Trichopoulou et al., 2003); for instance, in regions where the intake of monounsaturated lipid from olive oil is minimal, the numerator of the lipid ratio was considered as the sum of monounsaturated and polyunsaturated lipids (Trichopoulou et al., 2005).

The elevated intake of legumes, meat and dairy, as well as the irrelevant intake of olive oil, fish and wine by our sample, were expected, considering the Brazilian traditional food pattern. A study from the Brazilian Institute of Geography and Statistics (IBGE 2010) showed beans as the third more ingested food (72.8%) by the population. Among elders, excluding rice, beans, white bread and coffee, red meat (43.8%) and poultry (26.1%) were the first and the fourth foods with higher frequency of consumption, respectively. In addition, cheese (17.6%) was the sixth and whole milk (15.8%) the tenth more reported. They also showed a considerable consumption of sweetened fruit drinks (31.3%) and, besides white bread, foods like salty cracker, pasta, cake and corn were frequently consumed (Souza, Pereira, Yokoo, Levy, & Sichieri, 2013). Among the Brazilian population, the main alcoholic beverage consumed is beer, with a *per capita* intake of 31.1g per day, whilst wine presented a minimal *per capita* consumption (1.6g per day) (IBGE, 2010). Additionally, a study that estimated the dairy products intake using data from the first Brazilian nationally representative dietary survey (2008-2009) showed a higher consumption by elderly (average of 116.4g) compared to adolescents and adults (Possa, Castro, Sichieri, Fisberg, & Fisberg, 2017). Results from 2003 Health Survey of São Paulo (2003 ISA-Capital) showed an excessive consumption of red meat and processed meat among adults and elderly (106g/day) and it was associated with higher intakes of energy, total and saturated fat (de Carvalho, Cesar, Fisberg, & Marchioni, 2013). Besides, the consumption of red meat, pork and poultry were higher than fish intake among elders living in São Paulo in 2003 and 2008, with a lower intake of red meat and higher intake of poultry between this period (de Carvalho, Cesar, Fisberg, & Marchioni, 2014).

The Brazilian traditional food pattern described above was the main reason we included, in our analyses, a modification from the traditional MDP (our MPNM). We also took into account informations from other parts of the world. For instance, during a 43-year period (1961-1965 and 2000-2004), the availability of some food components of the traditional Mediterranean diet (olive oil, fruits, vegetables and fish) was higher in the region of Mediterranean Europe in relation to others geographical areas, including other European regions, other Mediterranean countries and countries from American continent (Vareiro et al., 2009). In addition, a study evaluating the adherence to MDP by Puerto Rican population, showed that olive oil was not the main contribution to monounsaturated fatty acid intake; the same difference was observed in relation to alcohol and wine intake (Mattei et al, 2017). A similar profile is noticed in Chile, with studies showing a low consumption of olive oil compared to Spain and Italy (Rozowski & Castillo, 2004) and a moderate adherence to the Mediterranean diet by the majority of the adult population (56%) (Echeverria et al., 2016).

In our data, the higher adherence to both views of pattern was characterized by greater intake of beneficial components (vegetables, legumes, fruits and nuts, cereals, fish, and olive oil), and lower intakes of components presumed to be detrimental in excess (dairy products and meat). Trichopoulou et al. (2003) corroborated these findings, showing similar characteristic in Greek population with higher adherence to the MDP. Although there was no difference between the degree of adherence to the MPOL and to the MPNM (moderate adherence was found to the both views), a greater number of participants were classified with a higher (moderate and high) adherence to the MPNM, compared to the MPOL adherence. Therefore, when quantifying or classifying the degree of adherence to the MDP, it is highly recommended to consider the quality and particularities of the MDP components. Dismissing these two aspects may lead to the construction of a food pattern that does not represent the Mediterranean diet, especially in studies with non-Mediterranean populations (Martínez-González et al., 2017).

Considering the favorable role of the Mediterranean diet on health, this diet is recognized as an Intangible Cultural Heritage of Humanity by UNESCO (2010) and documented as a healthy dietary pattern in the Dietary Guidelines for Americans 2015–2020 of the United States Department of Agriculture (2015). In addition, some studies have proposed strategies to the American population and other non-Mediterranean populations to achieve a greater similarity to the Mediterranean diet (Martínez-González et al., 2017; de Lorgeril et al., 2018). Therefore, a detailed evaluation of the adherence to the MDP, as developed in the present study, is essential to identify which strategies should be encouraged.

It is important, at this point, to highlight some limitations of our work. The first is that our sample represents only the elderly living in São Paulo, which makes it impossible to generalize these results for other regions. Future studies in Brazil should consider the food diversity of the Brazilian population. Besides, there is no collecting method of food consumption data capable of measuring the dietary intake totally error-free. On other side, as far as we know, this is the first study identifying the adherence to MDP by Brazilian elders. Another strength of the study is that food intake was assessed by two R24H and the MDS was determined by the usual consumption of the population.

Concluding, our results showed a moderate adherence to both MDP views by the Brazilian elders from Sao Paulo, SP. The inclusion of foods that are not characteristics of the Mediterranean diet overestimated the adherence to this dietary pattern, increasing the number of participants with high adherence.

Acknowledgments

The authors express their gratitude to Coordination for the Improvement of Higher Education Personnel (CAPES); to ISA-Capital staff; to the researchers of the Food Consumption Research Group (GAC), in special to its Coordinator, Dr. Regina Mara Fisberg, for allowing us to work with the databases. This work was supported by the São Paulo Municipal Health Department (grant number 2013-0.235.936-0), Research Support Foundation of the State of São Paulo (grant number # 2012/22113-9), and National Council for Scientific and Technological Development (grant number # 472873/2012-1, 402674/2016-2).

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5.2 SECOND MANUSCRIPT

Association between the adherence to the Mediterranean dietary pattern and Common mental disorders among community-dwelling elders: Data from 2015 Health Survey of São Paulo

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Abstract

Introduction: The benefits of the Mediterranean dietary pattern (MDP) on different aspects of health are widely known. However, there is a number of issues related to MDP that deserve more investigation. The present study intends to highlight some of these issues: (i) Is there significant associations between MDP and mental disorders in Brazilian elders? (ii) The MDP in non-Mediterranean areas is featured by the intake of foods quite different from the original Mediterranean ones. As such, are these differences associated to different benefits? **Aims:** (i) To evaluate the association between the adherence to the MDP with the presence of mental disorders in a representative sample of elders from Sao Paulo-SP-Brazil; (ii) To investigate these associations taking into account the intake of non-Mediterranean foods. **Methods:** The sample consisted of 545 elders from 2015 Health Survey of São Paulo, a cross-sectional population-based study. The presence of common mental disorders (CMD) was identified through the Self Reporting Questionnaire-20. Data from two 24-hour dietary recall were used to construct two points of view of MDP: Mediterranean pattern origin-like (MPOL), which included only the original components of the Mediterranean diet, maintaining their original form (fresh, locally produced and not modified or with minimal modifications from their natural state); and Mediterranean pattern with non-Mediterranean procedures (MPNM), which included foods with non-Mediterranean characteristics or submitted to procedures that diverge from the original dietary pattern (alcoholic beverages other than red wine, several sources of monounsaturated and foods with industrial addition of sugar, salt and chemical additives). To perform the analyses, we adopted different models of logistic regression (significance level of 5%; Stata software v.14). **Results:** Moderate and high adherence to MPOL, compared to low adherence, was associated with a lower prevalence of CMD (OR: 0.54; 95% CI: 0.34-0.88, p =

0.013 and OR: 0.42, 95% CI: 0.19-0.95, $p = 0.036$), after adjustment for gender, age, body mass index, number of chronic diseases, per capita household income, physical activity and smoking status. However, as expected, the presence of CMD was not significantly associated with MPNM adherence. **Conclusion:** Our results suggest that greater adherence to the traditional Mediterranean diet can be considered a protective factor regarding mental disorders in Brazilian elderly. Nevertheless, food habits that include a notable consumption of non-Mediterranean foods can limit this effect. Thus, the present study emphasizes the need for nutritional strategies that encourage the elderly to maintain healthy food habits.

Key-words: Mediterranean dietary pattern, elderly, mental disorders.

1. Introduction

Common mental disorders (CMD), also known as minor psychiatric disorders, are characterized by physical and psychic symptoms: depressive thoughts, anxiety states, irritability, fatigue, insomnia, difficulty in memory and concentration, and somatic complaints (Goldberg *et al.*, 1994). Depressive-anxious mood and depressive thoughts consist the two main domains of symptoms (WHO, 2017). In general population, their prevalence can reach 30%, affecting more people with advanced age (Goldberg and Huxley, 1992; WHO, 2017). Their early identification, as well as preventive strategies, are important in order to avoid the development of more significant brain disorders.

Among the different possible preventive strategies to brain health, the diet has been described as an important factor. In this perspective, many studies have confirmed the potential benefits of the Mediterranean dietary pattern (MDP) on diverse outcomes related to mental and physical health (Morales-Ivorra *et al.*, 2018; Romagnolo and Selmin, 2017; Tanaka *et al.*, 2018). The main features of this dietary pattern are the consumption of fresh, locally produced and not modified or with minimal modifications from their natural state (Martinez-Gonzalez *et al.*, 2017; Hachem *et al.*, 2016).

Despite of the identified benefits of MDP, there are some important aspects to highlight, when studying the MDP in non-Mediterranean areas. In these areas, although most of the selected foods can be generically included in the same MDP components, they are modified in terms of home preparation and/or industrial modifications (Vareiro *et al.*, 2009; Slimani *et al.*, 2009; Moubarac *et al.*, 2017; Baker and Friel, 2014; Louzada *et al.*, 2015). Possibly these types of modifications can result in different effects on general health (Dhaka *et al.*, 2011; Rauber *et*

al., 2018; Quirk *et al.*, 2013). Therefore, we assume that when conducting studies outside Mediterranean regions investigating this relationship, it is essential to consider different aspects of food habits among populations.

As such, the aims of this study were: (i) to evaluate the association between the adherence to the MDP with the presence of CMD in Brazilian elders; (ii) to identify if the presence of foods, or foods modifications, different from the MDP is able to modify this association. As far as we know, there are no studies that investigated the relation between CMD and the adherence to MDP in Brazilian elderly.

2. Methods

2.1 Study sample

This study includes data from a population-based cross-sectional study from São Paulo State, Brazil, carried out since 2001, with the aim to evaluate the health status of the population, and different associated factors. The editions of this study carried specifically in São Paulo City, SP, Brazil (ISA-Capital), were performed in 2003, 2008 and 2015 (Alves *et al.*, 2018), and the present study included only the data of 2015. People residing in permanent private households in the urban area of São Paulo city were randomly selected, from September 2014 to December 2015.

The sample was stratified by clusters, which was performed in two stages: census tracts, stratified in five Regional Health Coordination of São Paulo city (north, mid-west, southeast, south and east) and domiciles. In the first stage, 30 census tracts of each coordination were randomly selected, totalizing 150 primary units of sampling in the municipality. In the second stage of each census tract, an average of 18 households was systematically selected. All the persons from the families who belonged to the demographic domain selected in the study and who met the inclusion criteria (people of both genders, aged 12+ years and residing in the urban area of São Paulo during the period of the survey) were interviewed. The exclusion criteria were: individuals with chronic alcoholism, those on an enteral and/or parenteral diet, and pregnant or lactating.

In order to minimize the effects of losses and refusals, larger independent random selections were performed, securing a sample that allowed the estimation of proportions of the differences of 0.50. The sampling error was seven percentage points, considering a 95% confidence level and a delineation effect of 1.5.

Among the 4059 invited people who agreed to participate in 2015 ISA-Capital, 1737 were randomly selected to participate in the first phase of 2015 ISA-Nutrition, a study which included nutritional data. More details about 2015 ISA-Capital and 2015 ISA-Nutrition were previously published (Alves *et al.*, 2018; Fisberg *et al.*, 2018).

The present study included only data from elderly (age ≥ 60 years) of both genders, who also had their food consumption data collected in 2015 ISA-Nutrition. A total of 545 individuals were randomly selected to participate in 2015 ISA-Nutrition, responding the first 24-hour dietary recall (R24H) and therefore composing the sample of this study.

The 2015 ISA-Capital and 2015 ISA-Nutrition were approved by the Research Ethics Committee of the Faculty of Public Health of the University of São Paulo, protocols 32344014.3.3001.0086 and 30848914.7.0000.5421, respectively. All individuals included in the survey had their data collected only after signing the Informed Consent Form.

2.2 Dietary Assessment

Food consumption data were obtained by applying two non-consecutive R24H within one year, covering all days of the week and all the seasons. The first R24h was applied during a first domicile visit and was completed based on the Multiple Pass Methods (MPM), developed by the US Department of Agriculture (USDA), with the aim of reducing errors in the dietary measurement (Raper *et al.*, 2004). The second R24h was applied through telephone calls using the interview system incorporated into the Nutrition Data System for Research (NDSR, version 2014, developed by the Nutrition Coordination Center, University of Minnesota, Minneapolis, MN, USA United States of America). This software has as main database the US Food Composition Table developed by the USDA. All data were entered in the NDSR software (version 2014). Furthermore, regarding all the food included in the ISA-Nutrition 2015 database, their nutritional values of energy and macronutrients were compared with values from a food composition of a Brazilian table of food composition (TACO, 2011) and corrected when required. Subsequently, habitual dietary intake was obtained using the Multiple Source Method (MSM), a statistical method which estimates the usual intake of food and nutrients consumed by the population identified in the two R24Hs (Haubrock *et al.*, 2011).

2.3 Exposure variable

The Mediterranean dietary pattern adherence was assessed using the Mediterranean-diet Score (MDS), proposed by Trichopoulou *et al.* (2003). To obtain the MDS, the nine proposed food groups, which are fish, vegetables, legumes, fruits and nuts, cereals and monounsaturated: saturated fat ratio, were verified individually among the participants; the ones whose consumption was below or above the median of their own group, received the punctuation of “zero” and “one”, respectively. An inverse score was assigned for consumption of meat and dairy products, above or below the median. All the food ingested were adjusted for total energy intake by both genders. For alcohol, a value of one was assigned to a moderate consumption between men (10 and 50 g per day) and women (5 and 25 g per day) and zero for consumption below or above these values for each sex. Thus, the total MDS ranged from 0 to 9, with higher scores indicating greater adherence to the Mediterranean diet pattern. To perform the analyses, the MDS was classified in low adherence (0-3), moderate adherence (4-5) and high adherence (6-9).

Following the methods mentioned above, the MDS was calculated considering two possible views of this dietary pattern: Mediterranean pattern origin-like (MPOL), which included only the original foods of the Mediterranean diet, maintaining as much as possible the statement of being fresh, locally produced and not modified or with minimal modifications from their natural state; and Mediterranean pattern with non-Mediterranean procedures (MPNM), which included foods with non-Mediterranean characteristics or submitted to procedures that diverge from the original dietary pattern (alcoholic beverages other than red wine, several sources of monounsaturated and foods with industrial addition of sugar, salt and chemical additives). The inclusion of foods to construct each pattern was based on the proposed by Martínez-González *et al.* (2017).

2.4 Outcome variable

The presence of CMD was defined using the Self Reporting Questionnaire (SRQ-20) scores, validated in Brazil in the 1980s (Mari and Williams, 1986). The 20 questions of this instrument present the possibilities of dichotomous responses (yes/no) and involve physical and psychic symptoms grouped in four domains: depressive-anxious mood, a decrease in vital energy, somatic symptoms and depressive thoughts. In addition, all the 20 questions were asked with reference to the 30 days preceding the interview. The cutoff point used for positive answers was five, for both genders; therefore, a score above five indicates CMD suspicion (Scazufca *et al.*, 2009).

2.5 Covariates

2015 ISA-Capital data were obtained through the application of a structured questionnaire, organized by thematic areas. In the present study, sociodemographic variables (gender - male and female; age - ≤ 70 and > 70 ; marital status - with partner and without partner; years of formal education - ≤ 9 , 10-12, > 12 and *per capita* household income - ≤ 1 minimum wage, > 1 and < 3 minimum wage, > 3 minimum wage), lifestyle (physical activity and smoking status - never smoked, former smoker, current smoker), anthropometric variable (Body Mass Index - BMI) and health status (number of referred chronic diseases – 0, ≥ 1 , including diabetes mellitus, high blood pressure, dyslipidemia, arthritis or arthrosis or rheumatism and cerebrovascular accident) were used.

The physical activity level was determined from the International Physical Activity Questionnaire (IPAQ) - long version, previously validated in Brazil (Matsudo *et al.*, 2001). This variable was categorized as follows: do not comply with recommendation (< 150 minutes/week) and comply with recommendation (≥ 150 minutes/week). These recommendations are in accordance with the World Health Organization – WHO (WHO, 2011). The BMI was calculated by dividing the weight (kg) by the squared height (m^2), self-reported measures, and classified according to Pan American Health Organization (PAHO, 2002) (below normality range: $\leq 23 kg/m^2$; normality range: > 23 and $< 28 kg/m^2$; overweight: ≥ 28 and $< 30 kg/m^2$; obese: $\geq 30 kg/m^2$). The presence or absence of chronic diseases was also self-reported when asked if a doctor had already confirmed the presence of a certain disease.

2.6 Data Analysis

Covariates (categorical variables) were described by percentage of absolute frequency. The adherence to the MPOL and MPNM was defined in three degrees: Low (0-3), Moderate (4-5) and High (6-9). The outcome was categorized regarding the presence or absence of CMD. Fisher's exact test was used to compare the presence of CMD according to sociodemographic, lifestyle, anthropometric, health status variables and the degree of adherence to both dietary patterns.

To investigate the association between the presence of CMD and the adherence to the MPOL and MPNM, we used logistic regression fitted in two different models. model 1 is crude regression and model 2 is adjusted for gender, age, BMI, number of referred chronic diseases, per capita household income, physical activity, and smoking status. Potential confounding variables maintained in the final model were selected for biological plausibility.

All the statistical tests were two-tailed, considering a p-value <0.05 as significant. The analyses were undertaken in Stata software (Stata/SE 15.1 StataCorp College Station, Texas) considering the sampling weight.

3 Results

Table 1 depicts general characteristics of the participants. They were women in majority (55.3%), below 70 years old (62.1%), living with a partner (53%), with formal education lesser than nine years (66%) and *per capita* household income below three minimum wages (84.3%).

With regard to health variables, the presence of CMD was identified in 31% of the participants. In addition, 44.5% presented BMI within the normality range, although an expressive percentage showed to be above the normality (36.9%); the majority (76.9%) referred living with one or more chronic diseases. The lifestyle variables pointed that 61.8% of the participants never smoked; 84.7% did not comply with physical activity recommendations. Finally, the Mediterranean dietary patterns investigated were found to be mainly moderate (46.7%) and low (37.1%) to MPOL, and moderate (49%) and low (30%) to MPNM.

The presence of CMD was significantly associated with gender ($p<0.001$), the compliance with physical activity recommendations ($p=0.044$) and with the presence of chronic diseases ($p<0.001$).

Table 1. Descriptive findings of the participants according to Common Mental Disorders. São Paulo, Brazil, 2015.

Variables (n = 545)	N	%	Presence of Common Mental Disorders		P ¹
			No (n=361)	Yes (n=182)	
Gender					<0.001
Male	234	44.7	188	45	
Female	311	55.3	173	137	
Age					0.710
≤70	329	62.1	221	108	
>70	214	37.9	140	74	
Marital status					0.084
With partner	279	53	195	84	
Without partner	262	47	164	98	
Years of Formal education					0.108
≤ 9	382	66	243	139	
10-12	74	14.6	54	20	
>12	86	19.4	63	23	
Per capita household income					0.596
≤ 1 MW ²	179	37.2	117	62	
> 1 and < 3 MW ²	193	47.1	123	70	
> 3 MW ²	62	15.6	44	18	
BMI (kg/m²)³					0.717

Below normality range	103	18.6	68	35	
Normality range	228	44.5	153	75	
Overweight	69	13.7	50	19	
Obese	129	23.2	83	46	
Number of referred chronic diseases					<0.001
0	126	55.5	104	22	
≥1	394	44.5	245	149	
Physical activity					0.044
Complies with recommendation	84	15.3	64	20	
Does not comply with recommendation	456	84.7	295	161	
Smoking status					0.489
Never smoked	333	61.8	227	106	
Former smoker	139	24.9	90	49	
Current smoker	70	13.3	43	27	
⁴MPOL					0.282
Low	210	37.1	131	78	
Moderate	254	46.4	172	81	
High	81	16.5	58	23	
⁵MPNM					0.934
Low	157	30	103	54	
Moderate	277	49	184	93	
High	109	21	74	35	

¹Fisher's exact test was used; ²MW: Minimum wage value in 2015 was 224.02 USD; ³BMI: Body Mass Index (Below normality range: <23kg/m²; Normality range: 23 to 28kg/m²; Overweight: 28 to 30kg/m²; Obese: >30kg/m²); ⁴MPOL: Mediterranean pattern origin-like (included only the original foods of the Mediterranean diet, wine for alcohol and olive oil for monounsaturated lipid); ⁵MPNM: Mediterranean pattern including non-Mediterranean foods included foods with non-Mediterranean characteristics or submitted to procedures that diverge from the original dietary pattern (included alcoholic beverages other than red wine, several sources of monounsaturated and foods with industrial addition of sugar, salt and chemical additives).

Table 2 shows the result from logistic regression models in relation to the degrees of adherence to the MPOL and CMD. No association was founded in the crude regression (model 1). However, in the adjusted model (model 2), maintaining the low adherence as reference, a moderate and high adherence was associated with significantly lower prevalence of CMD. In addition, compared with those in the low adherence to the MPOL, participants with moderate and high adherence presented 46% and 58% lower odds of CMD, respectively.

Table 2. Association between adherence to Mediterranean patterns origin-like and Common mental disorders. São Paulo, Brazil, 2015.

MPOL	Model 1		Model 2	
	OR (95% CI)	p	OR (95% CI)	p
Low	Ref		Ref	
Moderate	0.71 (0.47-1.09)	0.125	0.54 (0.34-0.88)	0.013
High	0.59 (0.31-1.12)	0.108	0.42 (0.19-0.95)	0.036

Model 1: crude regression; Model 2: adjusted for gender, age, BMI, number of chronic diseases, *per capita* household income, physical activity, and smoking status.

Table 3 points that there was no significant association between the MPNM adherence and CMD in crude model, which is similar to the MPOL analysis. However, in model 2, even after the adjustment, there was still no significant association between the adherence to the MPNM and CMD.

Table 3. Association between adherence to Mediterranean pattern including non-Mediterranean foods and Common mental disorders. Sao Paulo, Brazil, 2015.

MPNM	Model 1		Model 2	
	OR (95% CI)	p	OR (95% CI)	p
Low	Ref		Ref	
Moderate	0.93 (0.56-1.54)	0.769	0.99 (0.50-1.95)	0.973
High	0.90 (0.48-1.69)	0.735	0.68 (0.29-1.58)	0.366

Model 1: crude regression

Model 2: adjusted for gender, age, BMI, number of chronic diseases, *per capita* household income, physical activity, and smoking status.

4 Discussion

In this study, we investigated the association between the MDP and the presence of CMD in elders. In addition, we established two different views of MDP to run this investigation. The presence of CMD was identified in 31% of the participants, where 25% of this identification come from the women. The level of adherence to the MDP was found to be from low to moderate for both the different views of this dietary patterns. We found significant difference between gender, number of referred chronic diseases and physical activity recommendation in relation to the presence of CMD. A greater adherence to the traditional Mediterranean diet showed to be significantly protective against CMD. In contrast, there was no association between the adherence to the MDP with CMD, when foods characteristics were different from the traditional MDP.

Results with similar results from us were identified in another municipality of São Paulo. Borim *et al.* (2013) found a prevalence of CMD in elderly of 29,7% from elderly, where the higher prevalence was found in women, in participants with sedentary lifestyle and with chronic diseases. In general, women are more likely to have mental disorders, and some reasons to this can be mentioned: the hormonal behavior during life; gender discrimination; and greater exposure to violence (Kuehner, 2017; Li and Graham, 2017). Regarding physical activity, it is well known its association with immunological, psychological and physiological responses capable of improving the state of stress, anxiety and depression (Mikkelsen *et al.*, 2017). Finally, the presence of chronic diseases increases the risk of hospitalizations, polypharmacy and consequently social isolation, all of these factors impairing the state of mental health (CDC, 2013). A longitudinal study proposed a bidirectional relation between chronic diseases and mental health (Chen *et al.*, 2017).

In our study, as well as in others, the higher adherence to the traditional Mediterranean pattern was associated with a lower prevalence of CMD in the elderly. Hernández-Galiot and Goñi (2017) showed through a cross-sectional study with non-institutionalized elders from

Spain, a protective effect of the Mediterranean diet on cognition. The beneficial effects of this dietary pattern on mental and physical health were also identified by Munoz *et al.* (2009) and Masana *et al.* (2018). Studies developed in non-Mediterranean populations also showed the benefits of greater adherence to the MDP on outcomes related to physical and mental conditions (Ntanasi *et al.*, 2018; Veronese *et al.*, 2018; Skarupski *et al.*, 2013). However, it is important to highlight that in a number of studies performed outside Mediterranean area, there was not any description of the characteristics of the foods included in the MDP; in addition, the studies adopted different methods to evaluate the adherence to the Mediterranean diet.

Our findings showing the association between the adherence to the MPNM with CMD are in agreement with a study that included elderly living in Norway (André *et al.*, 2017). Results from that study showed that, compared to a healthy dietary pattern, the inclusion of sweetened foods and beverages, refined carbohydrate, sausages and whole milk (which the authors defined as unhealthy dietary pattern), was associated with a higher number of mental health problems, including depression and anxiety, as well as with worse life satisfaction. Therefore, a healthier dietary pattern, more similar to the original MDP (which we can compare to our proposed MPOL), can be protective against mental disorders (André *et al.*, 2017). Still supporting these statements, a meta-analysis that included 21 studies (5 cross-sectional, 4 case-control and 12 cohort) involving 117,226 participants from Mediterranean Europe, Asia, north America and Oceania, established similar results in relation to the risk of depression (Li *et al.*, 2017). To evaluate this relation, two dietary patterns were determined: healthy dietary pattern (characterized by high intakes of vegetables, fruits, whole grains, olive oil, fish, soy, poultry and low fat dairy) and Western-style/unhealthy dietary pattern (mainly characterized by a high consumption of red and/or processed meat, refined grains, sweets, high-fat dairy products, butter, potatoes and high-fat gravy, and low intakes of fruits and vegetables. Clinical interviews or self-report on a previous physician-made diagnosis of depression and antidepressant medication, or validated scales were used to diagnose Depression. According to the results, the Western-type dietary pattern was associated with an increased risk of depression (OR=1.18; CI: 1.05, 1.34; P=0.006), while a highest category of healthy dietary pattern, compared with the lowest, decreased the risk of depression (OR=0.64; CI: 0.57, 0.72; P<0.00001) (Li *et al.*, 2017). These results emphasize the importance to carry out the evaluation of the adherence to the Mediterranean diet in different populations and, starting from this analysis, to guide public policies in countries with a westernized diet to maintain healthier eating habits.

Even with the accelerate urbanization, demographic changes and globalization observed in the last years, the Mediterranean countries have maintained a greater consumption of foods

characteristic of the Mediterranean diet, although foods that do not characterize this diet are increasingly more available in those regions (Vareiro *et al.*, 2009; Kearney, 2010); these changes could, in the future, signify a reduction in the very well-known benefits of MDP. Although, as far as we know, these data were not presented by any study. What has been mentioned so far is an accelerated increase in overweight or obesity in some Mediterranean countries, which, according to some authors, is strongly influenced by this trend of westernization of the Mediterranean diet (GBD 2015 Eastern Mediterranean Region Obesity Collaborators; Bergeret *et al.*, 2016;).

In the present study, the significant association between CMD and the adherence to the MPOL was found after adjustment for important lifestyle variables (for example: body weight, chronic diseases, physical activity and smoking). This factor demonstrates that this association depends on the interaction between several contents besides diet. For future studies, different authors have suggested the inclusion, besides the diet, of additional factors as covariates, in the studies investigating predictors of brain health. For instance, it is important to take into account the Mediterranean lifestyle pattern, such as physical activity, quality of sleep and social support and interaction. The effects of the synergy between these lifestyle behaviors, as proposed, have not yet been established (Yannakoulia *et al.*, 2015; Bach-Faig *et al.*, 2011).

At this point, it is important to highlight some limitations of our study. Firstly, it is not possible to determine cause and effect relationship between the adherence to the MDP and CMD, due to our cross-sectional feature. Secondly, the information about the covariates was self-reported, which can contribute to the risk of bias. Thirdly, due to the specificity of the data investigated, our results should not be generalized for the elderly living in other regions of Brazil or of the other countries. On other hand, our study has some strengths such as the pioneering regarding the evaluation of the association between the adherence to the Mediterranean diet and mental health outcome in elderly living in Brazil, which can open additional questions with the same thematic. Besides, we worked with elderly, a segment of population who is commonly affected by mental disorders and included a representative sample from the municipality of São Paulo, which is the greater Brazilian urban center. As last strength, the food intake was assessed by two R24H, following a protocol carefully developed to minimize bias.

Concluding, the results from our study showed that higher adherence to a Mediterranean diet is significantly associated with lower prevalence of CMD only when the particularities of this diet were fulfilled. The covariates investigated here indicate that possibly, the benefits of MDP are optimally achieved when a combination of different lifestyle factors are taken into

account. Thus, to motivate the elderly to maintain his food habit based on the traditional Mediterranean diet, together with a healthy lifestyle, can be an important strategy to improve mental health. Longitudinal studies are necessary to clarify the associations found.

Acknowledgments

The authors express their gratitude to Coordination for the Improvement of Higher Education Personnel (CAPES); to ISA-Capital staff; to the researchers of the Food Consumption Research Group (GAC), in special its Coordinator, Dr. Regina Mara Fisberg, for allowing us to work with the databases. This work was supported by the São Paulo Municipal Health Department (grant number 2013-0.235.936-0), Research Support Foundation of the State of São Paulo (grant number # 2012/22113-9), and National Council for Scientific and Technological Development (grant number # 472873/2012-1, 402674/2016-2).

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7. FUNDING.

The research was funded by the SMS-SP (protocol 006/2014-SMS.G), São Paulo Research Foundation (FAPESP, protocol 2012/221139) and National Council for Scientific and Technological Development (CNPq, protocol 472873 / 2012-1).

In addition, the present study was funded by the Coordination for the Improvement of Higher Education Personnel (CAPES), through the provision of a master's degree scholarship.

8. CONCLUSION

The participants presented a moderate adherence to the traditional Mediterranean pattern and it was observed that the presence of foods with non-Mediterranean characteristics significantly changed the consumption of some components of this diet and consequently also influenced the degree of adherence. In addition, an inverse association was found between the adherence to the traditional Mediterranean dietary pattern and the presence of common mental disorders. On the contrary, the Mediterranean dietary pattern that included non-Mediterranean foods did not show significant protective association for the same outcome. Therefore, these results reinforce the importance of programs and policies that encourage the elderly population to maintain food practices consistent with a healthy dietary pattern.

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APPENDICES

APPENDIX 1 - 24-hour dietary recall

Recordatório alimentar de 24 horas – R24h



REGISTRO INDIVIDUAL DE INGESTÃO DE ALIMENTOS	
Nome do entrevistado: _____	Número do questionário: _ _ _ _ _ _ _ _ _ _
Sexo: Masculino (1) Feminino (2)	Data de nascimento: _ _ _ / _ _ _ / _ _ _ _ _ CPF: _ _ _ _ _ _ _ _ _ _ - _ _ _
Telefone(s) para contato: _____	E-mail: _____
Nome do entrevistador: _____ Código do entrevistador: _ _ _ _ _	
Data da entrevista: _ _ _ / _ _ _ / _ _ _ _ _	Dia da semana: Seg () Ter () Qua () Qui () Sex () Sáb () Dom () 1º dia () 2º dia ()
No dia de ontem, que horas o(a) Sr(a). acordou? _ _ h _ _ min	Quantas horas de sono o(a) Sr(a). dormiu ontem? _ _ h _ _ min

No dia de ontem, quais foram os alimentos e bebidas que o(a) Sr(a). consumiu desde a hora que acordou até a hora que foi dormir, incluindo balas, chicletes, cafezinhos e outros alimentos consumidos entre as refeições principais?

PARA O ENTREVISTADOR: registrar horários das refeições, nome das refeições, marcas comerciais, medidas caseiras, temperos, açúcar e sal adicionados, e utensílios como o tipo de colher, copo, xícara, prato, etc.

[illegible]

APPENDIX 2 – Self-Reporting Questionnaire (SRQ-20)

SAÚDE EMOCIONAL (Para pessoas com 15 anos ou mais)

BLOCO E

Farei uma série de perguntas sobre problemas e dores que podem ter incomodado o(a) Sr.(a) nestes 30 dias. O(a) Sr.(a) responderá apenas sim ou não, dando a resposta que mais se aproximar da sua realidade. Caso tenha algum comentário, por favor, aguarde e faça-o no final após eu concluir. Volto a lembrar que todos esses dados são confidenciais.

O(a) Sr.(a) teve algum destes problemas, nos últimos 30 dias?

E 01. Tem dores de cabeça frequentes?

1. não

2. sim

9. NS/NR

E 02. Tem falta de apetite?

1. não

2. sim

9. NS/NR

E 03. Dorme mal?

1. não

2. sim

9. NS/NR

E 04. Assusta-se com facilidade?

1. não

2. sim

9. NS/NR

E 05. Tem tremores nas mãos?

1. não

2. sim

9. NS/NR

E 06. Sente-se nervoso(a), tenso(a) ou preocupado(a)?

1. não

2. sim

9. NS/NR

E 07. Tem má digestão?

1. não

2. sim

9. NS/NR

E 08. Tem dificuldade de pensar com clareza?

1. não

2. sim

9. NS/NR

E 09. Tem se sentido triste ultimamente?

1. não

2. sim

9. NS/NR

E 10. Tem chorado mais do que de costume?

1. não

2. sim

9. NS/NR

E 11. Encontra dificuldade para realizar com satisfação suas atividades diárias?

1. não

2. sim

9. NS/NR

E 12. Tem dificuldades para tomar decisões?

1. não

2. sim

9. NS/NR

E 13. Tem dificuldades no serviço, seu trabalho é penoso, lhe causa sofrimento? (estudante → escola; dona de casa e aposentado → tarefas diárias).

1. não

2. sim

9. NS/NR

E 14. Sente-se incapaz de desempenhar um papel útil na sua vida?

1. não

2. sim

9. NS/NR

E 15. Tem perdido o interesse pelas coisas?

1. não

2. sim

9. NS/NR

E 16. O(a) Sr.(a) se sente uma pessoa inútil, sem préstimo?

1. não

2. sim

9. NS/NR

E 17. Tem tido a ideia de acabar com a vida?

1. não

2. sim

9. NS/NR

E 18. Sente-se cansado(a) o tempo todo?

1. não

2. sim

9. NS/NR

E 19. Tem sensações desagradáveis no estômago?

1. não

2. sim

9. NS/NR

E 20. O(a) Sr.(a) se cansa com facilidade?

1. não

2. sim

9. NS/NR

APPENDIX 3 - Form for collection of dietary supplement intake data

Formulário complementar do R24h (PREENCHIMENTO OBRIGATÓRIO)



O(A) Sr(a). está tomando algum suplemento alimentar (vitaminas, minerais ou outros produtos)?

(1) SIM Se sim, completar as seguintes informações:

(2) NÃO

Nome do suplemento:	Dose:	Frequência:
Nome do suplemento:	Dose:	Frequência:
Nome do suplemento:	Dose:	Frequência:
Nome do suplemento:	Dose:	Frequência:
Nome do suplemento:	Dose:	Frequência:
Nome do suplemento:	Dose:	Frequência:
Nome do suplemento:	Dose:	Frequência:
Nome do suplemento:	Dose:	Frequência:
Nome do suplemento:	Dose:	Frequência:
Nome do suplemento:	Dose:	Frequência:
Nome do suplemento:	Dose:	Frequência:
Nome do suplemento:	Dose:	Frequência:
Nome do suplemento:	Dose:	Frequência:
Nome do suplemento:	Dose:	Frequência:
Nome do suplemento:	Dose:	Frequência:

ENTREVISTADOR: Considera que a informação coletada com o entrevistado foi?

(1) Confiável

(2) Pouco confiável devido o participante ter sido incapaz de lembrar um ou mais alimentos

(3) Pouco confiável por outras razões. Qual? _____

APPENDIX 4 – Informed Consent Term applied in the first phase of 2015 ISA-Capital



Inquérito de Saúde no Município de São Paulo

Id.: _____

TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

O(a) senhor(a) está sendo convidado para participar da pesquisa: **Inquérito de saúde de base populacional no município de São Paulo 2014**. O objetivo deste estudo é avaliar o estado de saúde da população residente no município de São Paulo segundo as condições de vida e de saúde. Esta pesquisa é um estudo conjunto da Universidade de São Paulo e Secretaria Municipal de Saúde São Paulo.

Durante a pesquisa realizaremos uma entrevista com o(a) senhor(a) para coletar informações sobre sua saúde, seus comportamentos relacionados à saúde, o uso de serviços de saúde, bem como sobre suas condições socioeconômicas.

A sua participação neste estudo será muito importante. Com as informações coletadas vamos poder comparar os resultados com os demais inquéritos realizados em anos anteriores, e avaliarmos as mudanças ocorridas no município nos últimos 10 anos, para assim podermos propor novas informações de saúde a partir das necessidades identificadas. Estas informações poderão ajudar na elaboração de propostas para melhorar o atendimento de saúde da cidade de São Paulo.

Os desconfortos e riscos da pesquisa são mínimos. O(a) senhor(a) poderá sentir-se constrangido para responder alguma pergunta.

Os resultados obtidos serão utilizados apenas para fins de pesquisa, sem que ninguém, além do(a) senhor(a) e do grupo saiba que o(a) senhor(a) está participando dela. O(a) senhor(a) não terá nenhuma despesa com a pesquisa, bem como não será pago por participar dela.

A sua decisão pela participação ou não da pesquisa não é obrigatória e a qualquer momento o(a) senhor(a) pode desistir de participar, sem quaisquer prejuízos, inclusive quanto ao seu atendimento na unidade de saúde habitual.

Se tiver alguma dúvida sobre esta pesquisa, os pesquisadores responsáveis estarão à disposição para qualquer esclarecimento (contatos presentes no verso desta folha). Caso sinta necessidade de mais detalhes você pode também entrar em contato com os comitês de ética em Pesquisa que aprovaram esta pesquisa.

Se concordar em participar da pesquisa, pedimos que preencha os dados a seguir e assine.

Após ter entendido tudo o que está escrito neste documento e o que o pesquisador nos explicou, eu, _____,

CPF nº _____ aceito participar como voluntário desta pesquisa, e declaro que os dados que forneço nas duas vias deste termo (uma minha e outra do pesquisador) são verídicos.

APPENDIX 5 - Student file

Janus - Sistema Administrativo da Pós-Graduação



Universidade de São Paulo
Interunidades em Nutrição Humana Aplicada
Documento sem validade oficial
FICHA DO ALUNO

89131 - 10178578/1 - Amália Almeida Bastos

Email: aabastos@usp.br
 Data de Nascimento: 25/02/1991
 Cédula de Identidade: RG - 156358120002 - MA
 Local de Nascimento: Estado do Maranhão
 Nacionalidade: Brasileira
 Graduação: Bacharela em Nutrição - Universidade Federal do Maranhão - Maranhão - Brasil - 2013

Curso: Mestrado
 Programa: Nutrição Humana Aplicada (1)
 Data de Matrícula: 01/12/2016
 Início da Contagem de Prazo: 01/12/2016
 Data Limite para o Depósito: 03/06/2019
 Orientador: Prof(a). Dr(a). Sandra Maria Lima Ribeiro - 01/12/2016 até o presente. Email: smlribeiro@usp.br
 Proficiência em Línguas: Inglês, Aprovado em 01/12/2016
 Data de Aprovação no Exame de Qualificação: Aprovado em 06/04/2018
 Data do Depósito do Trabalho:
 Título do Trabalho:
 Data Máxima para Aprovação da Banca:
 Data de Aprovação da Banca:
 Data Máxima para Defesa:
 Data da Defesa:
 Resultado da Defesa:
 Histórico de Ocorrências: Primeira Matrícula em 01/12/2016

Aluno matriculado no Regimento da Pós-Graduação USP (Resolução nº 6542 em vigor de 20/04/2013 até 28/03/2018).

Última ocorrência: Matrícula de Acompanhamento em 28/01/2019

Impresso em: 18/02/2019 10:41:59

Janus - Sistema Administrativo da Pós-Graduação



Universidade de São Paulo
Interunidades em Nutrição Humana Aplicada
Documento sem validade oficial
FICHA DO ALUNO

89131 - 10178578/1 - Amália Almeida Bastos

Sigla	Nome da Disciplina	Início	Término	Carga Horária	Cred.	Freq.	Conc.	Exc.	Situação
MCM5880-3/5	Bioestatística I (Faculdade de Medicina - Universidade de São Paulo)	14/03/2017	24/04/2017	90	0	-	-	N	Pré-matrícula indeferida
ESP5100-1/3	Epidemiologia Básica (Faculdade de Saúde Pública - Universidade de São Paulo)	16/03/2017	17/05/2017	45	3	100	A	N	Concluída
NHA5706-2/2	Fragilidade no Idoso: Prevenção e Intervenções Relacionadas à Nutrição e Atividade Física	27/03/2017	23/04/2017	60	4	100	A	N	Concluída
FBA5728-4/4	Aprimoramento Pedagógico (Faculdade de Ciências Farmacêuticas - Universidade de São Paulo)	30/05/2017	26/06/2017	60	4	87	A	N	Concluída
MCP5835-3/7	Princípios de Análise de Dados e de Bioestatística (Faculdade de Medicina - Universidade de São Paulo)	07/08/2017	20/08/2017	60	4	90	A	N	Concluída
EAE5876-5/5	Economia da Alimentação e Nutrição (Faculdade de Economia, Administração e Contabilidade - Universidade de São Paulo)	07/08/2017	15/12/2017	120	8	100	A	N	Concluída
HNT5732-10/1	Métodos para Avaliação do Consumo Alimentar de Populações (Faculdade de Saúde Pública - Universidade de São Paulo)	22/08/2017	17/10/2017	60	4	90	A	N	Concluída
FBA5896-7/2	Tópicos em Ciência dos Alimentos e Nutrição II (Faculdade de Ciências Farmacêuticas - Universidade de São Paulo)	17/11/2017	25/01/2018	30	2	100	A	N	Concluída
FBA5897-3/2	Nutrigenômica do Câncer (Faculdade de Ciências Farmacêuticas - Universidade de São Paulo)	19/02/2018	25/02/2018	30	2	100	A	N	Concluída
FBA5870-8/1	Tópicos em Ciência dos Alimentos e Nutrição I (Faculdade de Ciências Farmacêuticas - Universidade de São Paulo)	26/02/2018	07/05/2018	30	0	-	-	N	Matrícula cancelada

	Créditos mínimos exigidos		Créditos obtidos
	Para exame de qualificação	Para depósito da dissertação	
Disciplinas:	20	25	31
Estágios:			
Total:	20	25	31

Créditos Atribuídos à Dissertação: 71

Observações:

1) Unidades de Ensino responsáveis pelo programa: Faculdade de Saúde Pública - Faculdade de Ciências Farmacêuticas - Faculdade de Economia, Administração e Contabilidade - Escola de Artes, Ciências e Humanidades..

Conceito a partir de 02/01/1997:
A - Excelente, com direito a crédito; B - Bom, com direito a crédito; C - Regular, com direito a crédito; R - Reprovado; T - Transferência.
Um(1) crédito equivale a 15 horas de atividade programada.

Última ocorrência: Matrícula de Acompanhamento em 28/01/2019

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