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TESI DI DOTTORATO IN

AN ECONOMETRIC ANALYSIS OF ALTERNATIVE MEDICINE AND HEALTH-RELATED BEHAVIOURS IN ITALY AND ENGLAND

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ABSTRACT

The thesis deals with the relations between Complementary and Alternative Medicine (CAM) and health-related behaviours and analyses the relationships between "Leisure Time Physical Activity" (LTPA) and other health-related lifestyles. Particularly, the thesis is divided into three chapters.

A systematic review of literature about the determinants of the CAM use is firstly carried out and some economics aspects related to alternative cure are emphasised. The review outlines that several topics still need further investigation to allow a convenient and efficient introduction of CAM therapies in the health care system.

The thesis aims to give a causal interpretation for the relations between CAM and health-related habits in Italy and England. In particular, in the second chapter, two econometric models - probit and recursive - are built to highlight the importance to take into account the issue of endogeneity. The results suggest that regular physical activity affects, in a significant way, CAM use in Italy. On the other hand, no causal interpretation may be given to the relationships between CAM and healthy lifestyles in England. In addition, a complete profile of the CAM users is outlined; globally, the estimates for Italian and English people indicate that CAM may be considered part of primary and tertiary prevention.

A causal relation between physical activity and other healthy behaviours is investigated. This is the first study that tries to assess the effect of LTPA on smoking and diet behaviours for a representative sample of general population. This is due to the remarkable difficulty in controlling for unobservable individual heterogeneity, which likely influences the estimates. To deal with this topic, the third chapter of the thesis focuses on the identification issue; in particular recursive probit models with both one and two exclusion restrictions are used to tackle the endogeneity of physical activity. Several tests are carried out to assess the validity of the instruments. The results suggest a positive and significant effect of leisure time physical activity on non-smoking habit and healthy diet.

Finally, the main conclusions of the work and the future developments are discussed.

INTRODUCTION

Complementary and Alternative Medicine (CAM) is a widespread type of health care in many Countries not only to preserve the general health, but also for the treatment of specific chronic conditions. In particular, CAM therapies are increasingly used by people with self-defined anxiety attacks and severe depression (Unützer et al., 2000; Astin et al., 1998; Honda and Jacobson, 2005) and, importantly, an even greater number of cancer patients use alternative cure together with mainstream cancer treatments to control symptoms and to enhance the quality of life (Cassileth and Deng, 2004). Furthermore, it is relevant to consider that in most Countries, CAM is not covered by national insurance systems, and the individuals using alternative cure pay almost all the costs out of pocket. This willingness to pay highlights the public's general acceptance of CAM and also suggests that unconventional therapies have benefits that outweigh their costs.

Several studies are focused on the determinants of CAM and the first chapter aims to review, in a systematic way, the most relevant papers discussing some important aspects related to the CAM use. The literature review was carried out referring to distinct issues: the problems of adverse selection and moral hazard in the demand for the covered alternative therapies; the relationships between traditional and complementary therapies; the relations between CAM and health-related behaviours; the reasons and satisfactions related to the CAM treatments. The discussion of the literature emphasises some important economic aspects related to the use of alternative medicine and also the weak points of the previous studies.

The second chapter reviews the literature on the relationships between traditional care and health behaviours. Relevance is given to the methodologies used to take into account the endogeneity problems caused by unobservable individual characteristics.
Then, an empirical model is proposed to assess the relationships between CAM use and health-related behaviours for Italian and English populations. Two econometrics models are applied. The first is a probit model, useful to define a complete profile of the CAM users in

Italy and England, and also to outline the endogeneity issue. Then, a recursive-probit model is used to establish the causal effects of healthy lifestyles on CAM use. Even though no exclusion restrictions are required to identify the system of equations, three instrumental variables are built to deal with the potential endogeneity of physical activity, healthy diet and non-smoking, respectively.

The third chapter investigates the causal effect of physical activity on other two healthy behaviours, healthy diet and non-smoking, for a representative sample of the Italian population. Purposely to assess these relations, a review of the specific literature is firstly conducted. Then, recursive probit regressions with one or two exclusion restrictions are carried out to tackle the endogeneity of lifestyles. In this case, this issue is even more relevant than in the second chapter because it is supposed that the choices regarding the adoption of lifestyles are presumably strongly dependent on the individual time preferences. Several statistical tests are carried out to evaluate the validity of the instruments and the absence of any bias of the estimates.

In the last chapter, the main original results of the thesis are discussed together with the main practical implications deriving from a more accurate knowledge of CAM use and healthy-related behaviours. Finally, the limitations of the present study are discussed and the future developments are also outlined.

1 ECONOMIC ASPECTS OF COMPLEMENTARY AND ALTERNATIVE MEDICINE. A SYSTEMATIC REVIEW

1.1 INTRODUCTION

People using Complementary and Alternative Medicine (hereafter CAM) are strongly increasing around the World. In the U.S., Barnes et al. (2008) show that almost 4 out of 10 adults had used CAM therapies during 2006; Wu et al. (2007) point out that, among women with depression, 54% had used complementary and alternative therapies during 2000 while McEachrane et al. (2006) show that 27.3% of veterans with cancer or chronic pain used CAM during the last year. Similar trends are observed also in Europe: Thomas and Coleman (2004) find that 10% of the population in the United Kingdom reported a CAM therapy from a practitioner in 2000; Steinsbekk et al. (2011) outline an increase in CAM practitioners in Norway from 9.4% to 12.6% in 2004-2008; analogous tendencies emerge in Ireland (Fox et al., 2010), Sweden (Nilsson et al., 2001) and also in other Countries, i.e. Australia (Maclennan et al. 2002), Taiwan (Shih et al. 2008) and Republic of Korea (Ock et al., 2008).

While it is clear that people are increasingly using CAM, it is less clear what really CAM is. This is because a formal definition of CAM still lacks and the identification of CAM treatments is done in a residual way: CAM is all that is not standard medical and preventive care (Medline, 2013). This includes vitamins, herbs, dietary supplements, acupuncture, medication, massage, movement therapies, relaxation techniques, spinal manipulation, healing touch and hypnotherapy. Other treatments, such as traditional healers, traditional Chinese medicine and homeopathy, are also considered CAM therapies (NCCAM, 2013).

Despite its increasing use, there is a lack of evidence on the economic aspects related to CAM use. There exists only few literature reviews not focused on the economic issues. Bishop and Lewith (2010) and Ernst (2000) discuss the demographic and health characteristics of the

CAM users; Harris et al. (2000) deal with the prevalence of CAM among general population of Australia, Canada, UK and USA; Astin et al. (1998) discuss the use of CAM by conventional physicians. On the other hand, important findings about the costs and benefits of spinal manipulative therapy are provided by White and Ernst (2000), who also outline that "existing literature on the economic analysis of CAM is sparse and of poor quality"; the status of insurance coverage for CAM and the obstacles to integrating CAM into mainstream medicine are analysed by Pelletier et al. (1999), while selection bias and moral hazard are disregarded.

Based on a systematic review of more than 50 inter-disciplinary empirical papers, this thesis aims to cover the current gap on the economic issues related to CAM use. Five main aspects about CAM use are analyzed, which might be of interest for health economics research.

The first issue is the relationship between the insurance coverage and CAM use. Standard moral hazard problems may arise, when the individuals are covered by health insurance and do not bear the full cost of care (Pauly, 1968): there is an incentive to demand more care than necessary. The existence of moral hazard in health market might be particularly exacerbated in the case of CAM, because medical efficacy of such treatments has not been verified and the risk of consumption below a positive cost-benefit ratio is more severe.

Secondly, the use of inappropriate or unnecessary care could be even more evident if we consider the relationship between CAM use and individuals with mental illness. The empirical evidence outlines that adverse selection and moral hazard play a central role in mental health markets (Frank and McGuire, 2000). At the same time, the inclusion of effective alternative therapies in public insurance coverage may have positive effects on the health of individuals. Thus, a better synergy is possible between traditional and complementary approaches for the treatment of mental health problems, hence a better allocation of the resources; the thesis will try to understand whether existing literature provides a response to this issue.

Furthermore, a combined use of traditional and alternative medicine might generate

unknown and side-effects for the health of citizens, thus increasing the costs of the national health service. On the contrary, from CAM therapies as substitute of traditional medicine, a cross-price elasticity issue may arise: in fact, individuals might use CAM therapies if they could not afford traditional cure. In this case, policy makers should pay attention to the cost of services included in the public insurance packages to prevent shifts of the demand for health services to therapies that may not be effective or even harmful.

In addition, the relations between CAM and health behaviours are very relevant to be analysed in health economics research. The initial stock of health capital, according to the Grossman's model (1972 a, b), depreciates over time but several acts of investments may affect the rate at which health depreciates. They include both conventional medical services and health behaviours (such as smoking, alcohol, physical activity) but also unconventional medical cure. The analysis of the effect of health habits on the use of alternative treatments can allow understanding better the relations between medical and non-medical inputs with relevant implications for developing health promotion programs and for guiding CAM and traditional practitioners.

Finally, the reasons that lead citizens to use alternative therapies are significant to be discussed, because special needs and expectations towards the National Health System could be outlined. This thesis will cover all these aspects.

This chapter is structured as follows. The inputs and methods used for this review are firstly presented. Then, an investigation is proposed about the associations between CAM use, insurance coverage and mental disorders. In third paragraph, the papers dealing with the relations between CAM use and health-related behaviours are reported. Then, the selection criteria between traditional medicine and CAM are analysed. The satisfaction degree of CAM users is examined as well as the demographic characteristics and health status in the fifth paragraph. Finally, the major findings are discussed and concluding remarks are provided in the last paragraph.

1.2 INPUTS AND METHODS

The thesis presents a systematic review of the empirical papers including econometric analysis of the CAM use determinants, focusing on the five economic aspects above introduced. The SCHOLAR database was referred from 1995 to 2013, and the papers selected among those documenting the relationships between CAM use and one or more among these aspects: gender, age, income, education, mental and physical health status, private and public insurance. The keywords used to extract the information from the database were: complementary and alternative medicine, use and users of alternative medicine, homeopathy, acupuncture, herbal medicine, econometrics, mental disorders, insurance, therapies, CAM and health behaviours.

Globally, this review is based on the contents of 56 references: 37 papers about random and representative samples of adult population; 5 studies about women samples (3 are based on representative sample and 2 on sick women), 8 papers discuss samples of adults suffering of chronic diseases and/or oncology pain or in care for HIV, 3 studies refer to adults suffering from mental illness, 3 papers refer to representative non-random samples (i.e. individuals covered by a private health insurance, workers and individuals not reporting the use of conventional care). The papers based on clinical samples are also included to outline that the relationships between CAM and the variables of interest do not change significantly. Studies on samples of children are excluded because their CAM use relates to the beliefs or/ and the use of alternative medicines by parents.

Further 20 papers on CAM use are excluded because not based on econometrics, so that the statistical significance of variables cannot be assessed; also, papers dealing with specific medical issues are not considered and their discussion is beyond the scope of this work.
For the whole dataset, Table 1.1 provides details about the main author, the year of publication, the number of respondents, the statistical methods used, the main characteristics of the sample and the results of the statistical analysis proposed by the authors.
A full discussion of the main contents and open issues is provided in the next sections.

Table 1.1. Results of selected papers on Complementary/Alternative Medicine (CAM) use[1].

First author (year), [statistical method]	Sample characteristics	CAM use variable	Significant positive predictors	Non-significant predictors
Adams J. (2003) [Mean comparison]	Women aged 18-23 years [14779], 45-50 years [14099], and 70-75 years [12939]; random and representative sample of the national population of women in the target age groups, Australia(Health Insurance Commission database, 1996)	Use CAM provider in the previous 12 months – young women	Area of residence (non urban areas), education (high), employment status (employed), number of symptoms (higher), presence of chronic conditions, mean score on SF-36 dimensions (poorer general health, physical, emotional and mental health, bodily pain, lower vitality), major personal illness	Marital status, mean score on SF-36 dimensions (physical functioning), menopause in previous year, current smokers, consume alcohol at risk levels
		Use CAM provider in the previous 12 months in - mid age women	Area of residence (non urban areas), education (high), employment status (employed), mean score on SF-36 dimensions (poorer general health, bodily pain, poorer physical, emotional and mental health, lower vitality), major personal illness, menopause in previous year, current smokers, consume alcohol at risk levels	Marital status, number of symptoms, number of chronic conditions
		Use CAM provider in the previous 12 months - older women	Area of residence (non urban areas), number of symptoms (high), mean score on SF-36 dimensions (lower levels of physical functioning, bodily pain, poorer physical, emotional and mental health, lower vitality), major personal illness	Marital status, education, number of chronic conditions, menopause in the previous year, current smokers, consume alcohol at risk levels
Artus M. (2007) [Mean comparison]	Adult patients aged ≥ 18 with musculoskeletal pain during the 12 months prior to the interview (North Staffordshire General Practice Research Network [138]	Cam use in the previous year	Age (middle age more likely than older patients), socio economic classes (intermediate and routine and manual occupations more likely than in professional and managerial occupations)	Gender, Chronic Pain Grade (CPG)
		Cam and Conventional treatment use in the previous year	Age (middle age more likely than older patients, gender (female)	Socio economic class, chronic Pain Grade (CPG)
Astin A. (1998) [Multivariate logistic regression]	Adults aged ≥ 18; random sample drawn from a representative national sample, US [1035]	CAM use within the previous year	Education (high), health status, (poorer), being classified as "cultural creative", holistic orientation to health, to have had transformational experience, anxiety, back problems, urinary tract problems, chronic pain	Negative attitudes toward or experiences with conventional medicine, race, gender, age, income
Bair A. (2002) Multivariate analysis]	Multiethnic sample of women enrolled in the Study of Women 's Health Across the Nation, SWAN [3307]	CAM use in the past 12 months	Race (White more likely than African American/Japanese/Chinese/Hispanic), age (younger), education (high), annual income (high), employed, primary language (English), smoking status (no current smokers), poorer health-related quality of life, physical activity (more), lower depression scores	Marital status, menopausal status
Barbadoro P. (2011) [Multivariate logistic regression]	Adults aged ≥ 18; random and representative sample of general population (Health status of the population and use of health services-ISTAT, 2005) [14,963]	Use of at least one CAM therapy including Manual Treatments, Homeopathy, Herbal Medicine and Acupuncture in the past three years	Gender (female), education (high), social class (upper), area of residence (North East more likely than North-West), chronic diseases (co morbidities), self reported health (good less likely than fair/bad)	Regular use of conventional medication

[1] In some papers the independent variable "CAM use" is analyzed for two or more sub-samples and with reference to different therapies.

First author (year), [statistical method]	Sample characteristics	CAM use variable	Significant positive predictors	Non-significant predictors
Barnes M. (2008) [Multiple comparisons]	Adults aged ≥ 18; ational representative survey US (National Health Interview Survey, 2007) [23,393]	CAM use in the past 12 months	Gender (female), age (30-69 more likely), race (Puerto Rican, Dominican, Mexican American and Central or South American more likely than Mexican), education (high), poverty status (not poor more likely than poor), health insurance (adults aged < 65 with public health insurance were less likely to use CAM than insured adults or adults with private health insurance), marital status (divorced, cohabiting, married and never married more likely than widowed), region (West more likely), leisure time physical activity (engage in regular activity more likely), body weight status (healthy weight), lifetime cigarette smoking status (former smoker), lifetime alcohol drinking status (current infrequent and moderate drinker more likely), hospitalized in the last year, number of health conditions (3-6 or more conditions more likely), high number of visits to a doctor, delayed conventional care because of worry about cost, did not receive conventional care because could not afford it.	None indicated
Bhargava V. (2012) [Multivariate analysis]	Adults aged ≥ 18; randomized national representative sample, USA (Medical expenditure panel survey) [48467]	1-Chirapratic use	Gender (female), hours of employment, self perceived health status (poor), chronic conditions (asthma, back and musculoskeletal problems), marital status (married and divorced more likely than widowed), ethnicity (non-Hispanic White), high risk tolerance Significant negative predictors: Price of chiropractic, health insurance (HMO, Medicare, Medicaid), chronic conditions (hypertension), gender (male), ethnicity (Non-Hispanic Black), smoking	Self perceived health status (excellent and very good), ethnicity (Non-Hispanic others)
		2-Acupunture and/or massage use	Out of pocket payments for chiropractor, children under age 18 not present in household, unearned income, education, to have back and musculoskeletal problems, race (Non Hispanic White) Significant negative predictor: Health insurance (Medicare, Medicaid), gender (male), smoking, race (Non-Hispanic Black), region (Northeast, Midwest and South)	Self perceived physical and mental health status, marital status, hours of employment
Blais R. (1996) [Mean comparison]	Adults aged ≥15; representative sample (Quebec Health Survey, 1987 and Quebec Health Insurance Board claims database)	CAM provider use during two weeks before the survey	Age (30-44 more likely), education (high), activity (working), household income (high), good health habits and better overall health (fewer with incapacity but more with chronic conditions)	Gender, marital status
Brown C. (2009) [Logistic regression model]	Adults aged ≥ 18; weighted sample representing African Americans (data from National Health Interview Survey, 2002) [4256]	CAM use in the past 12 months	Age (middle-aged to older), education (high), gender (female), region of residence (South more likely than Northeast), delayed care, higher number of health conditions, better health status compared to the previous year, number of physician visits, prescription medication use, physical activity (vigorous and moderate), activities of daily living (ADL) limitations, disease states (pain, recurring pain)	Family size, employment status, insurance status, able to afford care, health care seeking behaviour, depression/anxiety, number of E.R. visits, physical activity (strength), disease states (hypertension, lower back pain, arthritis)

First author (year), [statistical method]	Sample characteristics	CAM use variable	Significant positive predictors	Non-significant predictors
Burstein J. (1999) [Multivariate logistic regression]	Women, cancer patients; sample drawn from random selected hospitals in Massachusetts, 1993-1995)[480]	New use of CAM after the surgery	Age (younger), education levels (high), fear of recurrence, depression, great number of symptoms	Marital status, race, income
Druss G. (2000) [Multivariate logistic regression]	Adults aged ≥ 18 with mental conditions; sample drawn from National representative survey (Medical Expenditure Panel Survey, US 1996 (MEPS) [1803]	Any CAM use in the past 12 months	Age (≤40 more likely), gender (female), education (high school), region (West)	Psychotic , affective, anxiety disorder, other psychiatric disorder, fair or poor mental health, chronic medical condition, race, uninsured.
		CAM use for Mental Condition	Psychotic and affective disorder	Anxiety and other psychiatric disorder, fair or poor mental health, chronic mental condition, demographic data
Egede L. (2002) [Multiple logistic regression]	Adults aged ≥ 18; national representative survey of the U.S. population (Medical Expenditure Panel Survey, 1996) [21571]	CAM use during 1996	Gender (female), education (high), race (Whites and individuals of other race more likely than Hispanics and blacks), health condition (poorer more likely), employed, diabetes, diabetes in combination with other chronic conditions, area of residence (West> Northeast/Midwest/South), insurance status (individuals with private health insurance less likely than uninsured individuals)	Age, marital status, poor mental health
Fang L. (2007) [Multiple logistic regression analysis]	Adults aged ≥ 18; Chinese Americans patients with mental illness (Community Health centers in New York)[153]	Current CAM use	Age (older), gender (female), employment status (employed)	Education, insurance coverage, mental and physical functioning, stigma toward mental illness, traditional beliefs about mental illness
Fox P. (2010) [Multivariate analisys]	Adults aged ≥ 18; national representative samples (National Survey of Lifestyles, Attitudes and Nutrition, Ireland, 2002) [5992]	CAM use in 2002	Age group (40-59), educational status (high), employment status (self employed), private health insurance, location, membership of a religious group, presence of moderate and severe pain, depression, anxiety	Gender, age group (60+) , employment (employee, student, sick /disabled/other)
Graham R. (2005) [Multivariable logistic analysis]	Adults aged ≥ 18; random sample of US population (NHIS, 2002) [31044]	CAM use in the past 12 months	Gender (female), education (high), race (Non- Hispanic White more likely than Non-Hispanic Black and Hispanic), income (high), insurance status (no insured), self perceived health status (fair/poor), region of residence (west more likely), last visit to health professional (> 6 months less likely to use CAM)	Age, marital status
Hanssen B. (2005) [Multivariate logistic regression]	Adults aged >16; representative sample of Norway population, 1997 [1000]	Ever use of CAM in Norway	Gender (female), age (30-59), education level (high), reported health status (poorer), visits to a medical doctor	None reported
	Adults aged > 16; representative sample of Denmark population (SUSY-2000) [16690]	Ever use of CAM in Denmark	Gender (female), age (30-59), education level (high), reported health status (poorer), visits to a medical doctor (frequent)	None reported

First author (year), [statistical method]	Sample characteristics	CAM use variable	Significant positive predictors	Non-significant predictors
	Adults aged 16-84; Representative sample of Stockholm population, 2000[1001]	Ever use of CAM in Stockholm County	Age (30-59), education level (high)	Gender
Honda K. (2005) [Multiple logistic regression]	Adults aged 25-74; representative national survey, US (Midlife Development in the United States Survey, 1995)[3,032]	CAM use in the past 12 months	Gender (female), education (high), psychiatric disorders (mayor depression and panic disorders), personality traits (openness and extraversion), control strategies (secondary control), social support and strain (friend support and family strain)	Age, race, marital status, insurance coverage, physical disorders, social support and strain (partner and family support)
Hsiao An-Fu (2006) [Multiple logistic regression models]	Adults aged ≥ 20; weighted sample of population in California population (California Health Interview Survey of CAM, 2003) [9187]	Asian who used Asian specific CAM[1203]	Age (36-64), health status (cancer), acculturation factors (not proficient in English)	Gender, education, income, self rated health, religious, spirituality, length of US residence, insurance, delay/not receiving conventional medical care
		American Indians who used American Indian – specific CAM [322]	Education (high), health status (cancer), religious (very, moderately and slightly religious less likely than no religious)	Age, gender, income, self rated health, insurance status, delay/not receiving conventional medical care
		African Americans who used African American - specific CAM [924]	Age (≥ 65 less likely), gender(female), health status (chronic illness and cancer), religious (moderately and very religious more likely), spirituality (very spiritual), length of US residence (immigrant 0-9 years less likely)	Education, income, self rated health, insurance status, delay/not receiving conventional medical care.
		Latinos who used Latino specific CAM [2188]	Health status (cancer), spirituality (very spiritual), acculturation factors (speak English well), length of US residence (immigrant 0-9 years less likely)	Age, gender, education, self rated health, religious, length of US residence, insurance status, delay/not receiving conventional medical care
		Whites who used White specific CAM [3513]	Gender (female), income (> $ 10,000), health status (chronic illness and cancer), religious (slightly, moderately and very religious less likely), spirituality (slightly, moderately and very spiritual more likely)	Age, education, self rated health, acculturation factors, length of US residence, insurance status, delay/not receiving conventional medical care
Hunt K. (2010) [Multivariate logistic regression]	Adults aged ≥ 16; random and representative sample of population in England (Health Survey for England, 2005) [7630]	CAM use in the past 12 months	Gender (female), education (high), anxiety and depression, work status (active employment), perceived social support (low), mental health (poor), diet of more portions of fruit and vegetables, use of vitamins/supplements	Race, household income, mobility problems, pain, member of religious organization
Hurwitz E. (2006) [Logistic regression analysis]	Adults aged ≥ 18; random and representative sample of Canadian [3505] and U.S. population [5183]	Use of Doctor of Chiropractic vs. General Practitioner only in Canada during the past 12 months[2882]	Age (<65 years), race (White), education (college), income (high), mental health visits (high), emotional problems (happiness with life), chronic conditions (arthritis), bodily pain, activity limitations due to the back or neck pain, quality of physician cure (fair or poor) and to not be satisfied with it	Gender, marital status, self-rated health smoking status, body weight, physical activity, hospitalization, prescriptions, medications, insurance, regular doctor, health care quality

First author (year), [statistical method]	Sample characteristics	CAM use variable	Significant positive predictors	Non-significant predictors
		Use of Doctor of Chiropractic only vs. General Practitioner and Doctor of Chiropractic in Canada during the past 12 months	Age (<45 years), gender (male), education (no college degree), self-rated health (better), chronic conditions (no or few), no bodily pain, no activity limitations, current smoker, body weight (not obese), physical activity frequency (infrequent), prescription drugs (no or few), no regular doctor	Marital status, race, income, emotional problems, physical activity, hospitalization, medications, insurance, health care quality and quality of Medical Doctor
		Use of Doctor of Chiropractic vs. General Practitioner only in U.S. during the past 12 months	Age (<65 years), race (White), depression, chronic condition (arthritis), bodily pain, activity limitations due to back or neck pain, body weight (obese), no regular doctor	Gender, education, marital status, income, self-rated health, smoking status, physical activity, hospitalization, medications, prescriptions, insurance, health care quality, quality of Medical Doctor
		Use of Doctor of Chiropractic only vs. General Practitioner and Doctor of Chiropractic in U.S. during the past 12 months	Age (younger), chronic conditions (no or few), prescription medications (no or few), no regular doctor, no health insurance, dissatisfaction with the quality of health care	Gender, education, race marital status, income, self-rated health, depression, mental health, activity limits, beck/neck problems, body weight, physical activity, hospitalization, medications, quality of Medical Doctor
Johnson Jo (2012) [Multivariate logistic regression]	Workers aged ≥ 18; representative sample drown from National Health Interview Survey, 2007) [14,329]	CAM use in the past year for employed U.S. adults by Industry	Industry (health care > all others), gender (female > male), age group (30-64 years more likely), ethnicity (Non Hispanic White and Non Hispanic other > Non Hispanic Black), nativity (US born > Foreign-born), insurance coverage (insured > uninsured), region (West more likely)	Ethnicity (Hispanic), health status, region (Midwest)
Josephs JS (2007) [Multivariate logistic regression]	Adults aged ≥ 18; random sample of infected patients with HIV (HIV Research Network, 2003) [951]	Use of Alternative Therapist in the past 6 months	Education (high), formerly using illicit substances, recent mental health visit, HIV risk factor (men who have sex with men)	Gender, race, insurance status, employment status
Lafferty W. (2006) [Linear regression model]	Adults aged 18-64; individuals enrolled during 2002 in a single private insurance plan (Health Maintenance Organization-HMO-Point of service-POS-, Preferred Provider Organization-PPO) [over 600,000]	Covered[2] use of CAM provider	Gender (female), age (31-50), enrollers in PPO and POS more likely than HMO, high utilizes of medical care	None reported
Lee GBW (2004) [Multivariate	Adults aged ≥21; random sample of patients with chronic	CAM use in the past 12 months	Several specific chronic disorders (arthritis, stroke and other musculoskeletal disorders), dissatisfaction with the quality of services and	Age, self reported health status, use of CAM in family, family and friends

[2] "In 1996, Washington passed a law mandating that all commercial health insurance companies cover the services provided by every category of licensed provider (ECOP)".

First author (year), [statistical method]	Sample characteristics	CAM use variable	Significant positive predictors	Non-significant predictors
logistic regression]	diseases (Singapore Health Services Polyclinics, 2003) [488]		care provided by the clinics, strong adherence to traditional health beliefs	recommendation
London S. (2003) [Multivariate logistic analysis]	Adults ages ≥ 18; national representative study of HIV (HCSUS, Baseline Sample United States 1996) [2745]	Use of Alternative Therapist in the past 6 months	Income (≥ $40,000), sexual orientation (gay/lesbian), geographic location (Northeast and West > South), screened positive for depression, information involvement, decision involvement	Gender, race, age, education, insurance status, any past-year drug use, heavy alcohol use past four week, discrimination by health care provider
Mackenzie R. (2003) [Logistic regression]	Adults aged ≥ 18; nationally representative randomized sample (National Comparative Survey of Minority Health Care, U.S.1995) [3789]	Use of at least 1 CAM modality including Herbal Medicine, Acupuncture, Chiropractic, Traditional Healer, Home Remedies	Gender (female), education (high), no insurance	Race, age, income,
		Use of Herbal Medicine	Race (African Americans, Latinos and Asian Americans more likely than Whites), gender (female), education (high), no insurance	Age, income and being foreign born.
		Use of Acupuncture	Race (Asian Americans > Whites), no insurance, age(65+)	Income, gender, education
		Use of Chiropractic	Race (Whites > African Americans, Latinos and Asian Americans), annual incomes (> $25,000 more likely)	Gender, education, insurance
		Use of Traditional Healer	Education (high)	Age, race income, gender, insurance
		Use of Home Remedies	Race (African Americans more likely than Whites, Asian Americans less likely), gender (female) no insurance, born in US	Age, income, education
Maclennan H. (1996) [Multivariate analysis]	Adults aged ≥15; representative population survey (South Australian Health Omnibus Surveys, 1993) [3004]	Use of CAM in the past year	Age (35-54 more likely), gender (female), education (high), work status (employed), consume of alcohol at risk level, BMI (normal weight), exercised in last two weeks	None indicated
		Use of Alternative Practitioners in the past year	Age (15-54 more likely), area of residence (country), consume of alcohol at risk level, BMI (overweight), exercised in last two weeks, optimistic outlook on life	None indicated
MacLennan H. (2002) [Multivariate logistic regression]	Adults aged ≥15; representative population survey (South Australian Health Omnibus Survey, 2000) [3,027]	CAM use in 2000	Age (younger), gender (female), education (high), household income (high), work status (employed)	None reported
MacLennan H. (2006) [Mean comparison]	Adults aged ≥15; representative population survey (South Australian Health Omnibus Survey, 2004)[3015]	Use of CAM in the past year	Age (25-44 more likely than 65+), gender (female), country of birth (Australia), marital status (separated/divorced less likely that married/never married/widowed), education (high), household income (>$30,000), area (metropolitan more likely than country)	Country of birth (UK and Ireland, Europe, Asian, others), marital status (married, never married and widowed)
McEachrane Gross P. (2006) [Bivariate analysis]	Group of oncology and chronic pain veterans; local survey (Campus of the Veterans Administration	CAM use in the past 12 months	Education (high), income (high), insurance status (insurance in addition to VA benefits), care outside VA (additional care), beliefs about cause of illness (lifestyle)	Gender, race, religion, employment status

First author (year), [statistical method]	Sample characteristics	CAM use variable	Significant positive predictors	Non-significant predictors
	Boston Health Care System, 2003) [264]			
McFarland B. (2002) [Multivariate logistic regression]	Adults aged ≥15; data from 1996 Canadian National Population Health Survey, 1996 and United States Medical Expenditure Panel Survey , 1996.	CAM use in Canada	Gender (female). age (20-64), education (high), race (Whites), area of residence (West), reported health status (poorer), problems with instrumental activities of daily living, to have seen a conventional physician in the previous year	None reported
		CAM use in United States	Gender (female), age (20-64), education (high), race (Whites), area of residence (West), to have seen a conventional physician in the previous year	Health status, problems with instrumental activities of daily living
Molassiotis A. (2005) [Multivariate logistic regression]	Adults aged ≥ 18; cancer patients from countries members of the European Oncology Nursing Societies [956]	CAM use before the diagnosis of cancer, since the diagnosis or currently	Gender (female), age (younger), education (high)	None reported
Nahin L. (2007) [Multivariate logistic regression]	Adults aged ≥ 18; representative sample of US population (survey conducted by National Center for Health Statistics, NHIS, 2002) [31,044]	CAM use in the past 12 months	Gender (female), age (younger than 65 more likely), education (high), income (high), employed (self-employed group), race (Asian or other Pacific Islander), living in the western U.S., physical activity (regular), no current heavy drinker, former smoker, no obese, number of reported health conditions (high), number of doctor visits (high)	Health compared to 12 months ago, health insurance status
Nahin L. (2010) [Multivariate logistic regression analysis]	Adults aged ≥ 18; sample of individuals who did not report using conventional care in the previous 12 months (NHIS, 2002)	CAM use among adults not using Conventional Care in the past 12 months	Gender (female), education (high), class of worker (self-employed) region of residence (West), leisure time physical activity (regular activity), alcohol drinking status (former and moderate drinker more likely), barriers to conventional care (delayed care due to cost and/or non-cost barriers)	Age, poverty status, born in the US, insurance coverage, smoking status
Ni H. (2002) [Multivariate logistic regression]	Adults aged ≥ 18; national representative sample (National Health Interview survey ,US, 1999) [30,801]	CAM use in the past year	Gender (women), age (35-54), education (high), area of residence (Midwest and West >Northeast or South), race (White non Hispanic more likely than Hispanic and black non Hispanic persons), to have a usual place for medical care and a customary health provider for medical care, to have visited a medical specialist or general medical doctor in the past year, to have entered emergency room in the past 12 months	Health insurance
Nilsson M. (2001) [Multivariate logistic regression]	Adults aged ≥ 25; random sample of population (Sweden MONICA Project, 1999) [5794]	CAM use during the last 14 days by men	Education	Age, self perceived health , cardiovascular disease or diabetes
		CAM use during the last 14 days by women	Age (55-64 more likely), education (high), self perceived health (poorer)	Cardiovascular disease or diabetes
Ock S. (2008) [Mean comparison]	Adults aged 30-69; sample representative of general South Korean population (Personal interviews, 2006) [3,000]	CAM use during the previous 12 months	Gender (female), age (50-59), region of residence (metropolitan), marital status (married more likely than never married people), work status (not employed), religion beliefs, education (under high school), monthly family income (high), self perceived health status (poor), having medical problems	
Oldendick R. (2000)	Adults aged ≥ 18; random	CAM use in the past 12	Age (30-45 more than younger or older), education (high), marital status	Gender, race, income, county of residence

First author (year), [statistical method]	Sample characteristics	CAM use variable	Significant positive predictors	Non-significant predictors
[Logistic regression models]	representative sample, South Carolina [1584]	months	(divorced o separated more likely than married, widowed or single)	
Rafferty A. (2002) [Multiple logistic regression]	Adults aged ≥ 18; population based telephone surveys of Michigan adults (Behavioural Risk factor Surveillance System-BRFSS, 2001)	CAM use in the previous 12 months	Gender (female), race (White more likely than Black), education (high), general health (poor)	Age, income
Richardson M. (2000) [Multivariate logistic regression]	Adults aged ≥ 18; cancer patients attending one of eight outpatients clinics at The University of Texas (M.D. Anderson Cancer Center, Houston, 1997-1998) [453]	At least one CAM therapy in any one of the seven CAM categories	Gender (female), age (younger), pay status[3] (indigent), surgery	None reported
Ritchie S. (2005) [Logistic regression]	Adults aged ≥ 18; representative national survey, USA (Medical Expenditure Panel Survey, 1998)[15,745]	CAM use	Access to care (barriers to obtaining care) visits to doctor (more) gender (female) , race (White more likely than Black, Non Hispanic more likely than Hispanic), area of residence (West), income (high), age (increasing but less in older)	Quality of care (dissatisfied with the quality of staff, dissatisfied with quality of care given by provider), insurance status, marital status, education
Rossi P (2005) [Multivariate logistic regression]	Adults aged 16-65; patients suffering from migraine and medication overuse headache + migraine and attending a headache centre in Grottaferrata (February 2002 to February 2003) [481]	Number of CAM treatments used	Number of headache specialists consulted (high), migraine subtype diagnosis (chronic migraine more likely than episodic migraineurs, annual household income (high), psychiatric co morbidity, self reported physician diagnosis (no diagnosis/incorrect diagnosis)	Gender, age, education level, marital status, disease duration, medication use
Roy-Byrne P. (2005) [Multivariate logistic regression analysis]	Adults aged 18-70 with symptoms of anxiety and depression; sample drawn from the baseline phase of Collaborative Care for Anxiety and Panic study (clinics in Seattle, San Diego, Los Angeles) [682]	Use of Herbal Remedies in the last 3 months	Education (high), depression diagnosis, lower burden of medical illness	Gender, age, race, marital status
Shih Shu-Fang (2008) [Multivariate analysis]	Adults aged ≥20; National Health Interview Survey, Taiwan 2001, National Health Insurance, Taiwan 2001	1-CAM use not covered	Age (25-64), gender (female), education (high), chronic conditions, residential area (Central), typical healthcare (Traditional Chinese more likely than Western medicine only), SF-36 health status measure (bodily pain), religion (Traditional and Buddhist), unhealthy behaviour (more)	Age (20-24), ethnicity, average annual household income, marital status, urbanization level, residential area (Northern, Eastern), SF-36 health status measure (physical and

[3] Statistically significant with $p < 0.1$

First author (year), [statistical method]	Sample characteristics	CAM use variable	Significant positive predictors	Non-significant predictors
				emotional role, social functioning vitality, mental and general health).
		2-CAM use covered[4]	Age (20-24 and 35-64 more likely), residential Area (Northern and Central), typical healthcare (Western end Traditional Chinese), SF-36 health status measure (bodily pain)	Gender,, education, ethnicity, average annual household income, religion, marital status, unhealthy behaviour, urbanization level, SF-36 health status measure (physical-emotional role, social functioning, vitality, mental and general health)
Steinsbekk A. (2007) [Multivariate logistic regression]	Adults aged ≥20; representative sample (cross-section survey conducted in Nord-Trondelag County-Norway-between 1995 and 1997) [65495]	CAM only users in the last 12 months	Gender (male > female), age group (30-69 > 70+), cardiovascular disease (less likely)	Marital status, education, social welfare benefits, smokes daily, global health, recent and chronic complaint, asthma, diabetes, musculoskeletal disease, epilepsy, psychiatric complaint, cancer, hay fever
		Both CAM and GP users in the past 12 months	Gender (female > male), age group (30-59 > 60+), education (middle level and university>compulsory school), global health (fair and poor>very good), yes recent and chronic complaint, no-smokers more likely, no cardiovascular disease, yes musculoskeletal disease, yes psychiatric complaint, hay fever	Married/cohabiting, social welfare benefits, smokes daily, asthma, diabetes, epilepsy, cancer, another chronic disease, injury
Steinsbekk A. (2011) [Multivariate logistic regression]	Adults aged ≥ 18; representative sample in one county in Central Norway: HUNT 3, conducted 2006-2008 [50,713]	CAM visitor during the last 12 months by female	Age group (30-59 more likely), daily smoker (less likely), global health (poorer), anxiety and depression, chronic and psychiatric complaint, disease (hay fever more likely), visit to a physician, visit to a chiropractor	Education, marital status
		CAM visitor during the last 12 months by male	Age (50+ less likely), marital status (widowed more likely), daily smoker (less likely), hard physical activity, global health (poorer), recent and chronic complaint, diseases (heart disease less likely), visit to a physician, visit to a chiropractor	Education, psychiatric complaint
Steinsbekk A. (2008) [Multivariate logistic regression]	Adults aged ≥ 20; data from a total population survey conducted 1995-1997 in Central Norway-HUNT 2 [40,027]	Visit to Homeopath during the last 12 months	Gender (female), age (30-39 years and 60+), education[5] (high), social welfare benefits[3], smoking (smokers less likely), global health (fair and poor health more likely than good), psychiatric complaint, recent complaint, chronic complaint, diseases (hay fever more likely, musculoskeletal disease, another chronic disease, anxiety and depression (HADS – T score 10-14 and 15-19)	Marital status, chronic complaint, asthma, heart disease, diabetes, epilepsy, cancer
Thomas K. (2004) [Mean comparison]	Adults aged ≥16; randomized representative national sample, UK [1794]	CAM use in the past 12 months	Age groups (middle age more likely than youngest and oldest groups but only for men), income (high gross income levels), education (full time education after the age of 18), social class (non manual)	Gender, age groups (for women)
Tinga B. (2002) [Maximum Likelihood	Adults aged ≥17; randomized national representative sample, USA	CAM use	Gender (female), education (high), region (West > South), marital status (previously married), race (White more likely than African American and Asian), health status	Age, total income, mental health status

[4] In Taiwan CAM therapies covered by National Health Insurance are: Chinese medicines, acupuncture, moxibustion and traumatology manipulative therapy.

[5] Statistically significant with $p < 0.1$.

First author (year), [statistical method]	Sample characteristics	CAM use variable	Significant positive predictors	Non-significant predictors
Estimates of the Probit model]	(Medical expenditure panel survey, 1998) [16,560]		(poorer physical health status)	
Unützer J. (2000) [Logistic regression model]	Adults aged ≥19; representative sample (National household telephone survey, U.S. 1997-1998) [9,585]	CAM use in the past 12 months	Gender (female > male), age (30-59 more likely than 60+), education (high), region (West), mental disorders (panic, major depression more likely than dysthymia), number of chronic medical illness (high), health insurance (individuals with private insurance more likely), general satisfaction with health care	Generalized anxiety disorder, work status, race
Upchurch M. (2004) [Weighted logistic regression]	Women aged ≥ 18; randomized representative survey, U.S. (National Health Interview Survey, 1999)[17399]	CAM use in the past 12 months	Age (35-54 > 18-24), race (White > Black, Hispanic, Asian), nativity (nativity US born > foreign born), education (> 12 years more likely), income (≥ $20,000 more likely), region (Midwest and West > South, Northeast less likely), self-rated health status (poor more likely)	Age (≥55), health insurance status
Van Gameren E. (2010) [Bivariate probit]	Adults aged ≥50; representative national panel survey, Mexico (Mexican Health and Aging Study with two waves 2001 and 2003) [22,729]	1-CAM use	Self assessed health status (poor), disease (cancer, arthritis), severe problems with adl, symptoms (stomach pain, indigestion), locality size >100,000 Significant negative predictors: Health insurance, age (70+)	Self assessed health status (good, fair), disease (heart attack, stroke, hypertension, diabetes), household income and assets, gender, age (60-69), number of years of education, speak indigenous language.
		2-CAM use by poor households (below the poverty line equals a monthly income of 1050 pesos per person)	Disease (heart attack, hypertension), severe problem with adl, symptoms (stomach pain), number of years of education (high) Significant negative predictors: Health insurance	Self assessed health, disease (stroke, cancer, diabetes), household income and assets, locality size, gender, age, married, speaks indigenous language
		3-CAM use by rich household	Disease (arthritis,) symptoms (stomach pain, indigestion) Significant negative predictors: Age (70+)	Health insurance, self assessed health, disease (heart attack, stroke, cancer hypertension, diabetes), severe problems with adl, household income and assets, locality size, gender, age (60-69), married, number of years of education, speaks indigenous language
Wahlstrom M. (2008) [Mean comparison and logistic regression]	Adults aged ≥30; representative sample of population living in mainland Finland (The Health 2000 study) [5987]	CAM use in the past 12 months	Gender (female), education (high), marital status (married/cohabiting), work status (employed), income (high), somatic disease	Are of residence, age, mental disorder
		CAM use in the past 12 months calculated for mental disorders diagnosis	Major depressive disorders, generalized anxiety disorders, alcohol dependence and abuse (less likely), panic disorders (10% significance)	Dysthymia, social phobia, agoraphobia

First author (year), [statistical method]	Sample characteristics	CAM use variable	Significant positive predictors	Non-significant predictors
Wolsko M. (2002) [Multivariate regression model]	Adults aged ≥ 18; representative randomized National sample, U.S. 1997-1998 [2055]	Use of CAM provider among patients who used a given CAM therapy in the last year	Gender (female), visits made to conventional provider in the last year (more), used CAM therapies for diabetes, cancer, back and neck problems	Age, education, income, race, region of residence, presence of psychiatric disorder
		Number of visits made to CAM provider during the last 12 months	Full and partial insurance coverage, used CAM therapy for wellness, used CAM therapy for back or neck problems	Age, gender, socioeconomic status, health status measures, presence of psychiatric disorder, region of residence
Wu P. (2007) [Multiple logistic regression analysis]	Women aged ≥ 18 who reported past-year diagnosed depression; weighted sub-sample taken from national representative survey, United States, 2001[282]	CAM use during the past year	Race (Non Hispanic White more likely than African American), education (college), work status (employed), marital status (unmarried more likely than married), self-perceived health status (poor), birth place (outside the US)	Age, income, region
Xue C.L. [Mean comparison]	Adults aged ≥ 18; representative sample of the Australian population, 2005 [1067]	CAM use in the previous 12 months	Gender (female), age (18-64> 65+), education (high), employment (Employed > Unemployed or not in labour force), private health insurance, annual households income (> $40,000)	Country of birth, region, self-reported health status

1.3 RELATIONSHIPS BETWEEN HEALTH INSURANCE AND CAM USE

The effects of insurance coverage on CAM are emphasized by many studies. For U.S. population, full and partial insurance coverage for alternative therapies is strongly associated with high frequency use of CAM providers (Wolsko et al., 2002); Barnes et al. (2008) outline that, among adults (younger than 65 years of age), there is a positive significant association between private health insurance and use of biologically, manipulative and mind-body therapies during 2007; Johnson et al. (2012) show a significant association between insurance coverage and CAM use for employed adults. Similarly, Xue et al. (2007) and Fox et al. (2010) highlight, respectively, that CAM use among Australian and Irish population depends, in a significant positive way, on private health insurance.
Nahin et al. (2007) report that people with private health insurance had grater probability to use CAM therapies while "those with public insurance had reduced odds of using CAM than those who were insured". However, after adjusting for the other variables, the relationship between private health insurance and CAM use is not significant. Analogously, Ni et al. (2002) highlight that, among American population, CAM use is higher for persons who have health insurance but adjusting for age, gender, and education, the difference is not statistically significant. Furthermore, London et al. (2003) show a significant relationship between the number of visits by alternative therapists and having private health insurance in his study on individuals in care for HIV. In addition, individuals covered by private health insurance and suffering from mental health problems are pointed out as more likely to use alternative therapies compared to public insured individuals (Unutzer et al., 2000). Furthermore, Lafferty et al. (2006), based on individuals covered by private health insurance, outline that several people had used CAM insurance benefits; however "the effect on insurance expenditures was modest".

Some papers (Bhargava et al., 2012; Unutzer et al., 2000; McEachrane et al., 2006; Van Gameren, 2010; Barnes et al., 2008) suggest that people covered by public insurance prefer using traditional rather than alternative therapies. In particular, Van Gameren (2010) shows a negative effect of health insurance on CAM use, with a different impact on poor and rich

household: strong and significant effect for the former, opposite for the latter.
Others studies (Mackenzie et al., 2003; Graham et al., 2005; Hurwitz et al., 2006; Egede and Ye, 2002) point out that uninsured people are more likely to use CAM, thus the choice between traditional and alternative medicine seems closely linked to individual economic resources. However, people may use health services not only influenced by the economic factors, but selectively. The latter case is that of Taiwan, where there is a higher demand for non-covered alternative therapies such as healing, chiropractic, acupuncture than for Chinese medicine, acupuncture, manipulative therapies and moxibustion that, differently, are covered by insurance (Shih et al., 2008).

However, for all these studies, the validity of relationships between CAM use and insurance status should be assessed, considering selection bias and moral hazard issues: do the people choose any covered alternative cure because they plan to use alternative therapies or because they have given coverage? Hence, from the econometric point of view, insurance status is suspected to be an endogenous variable. Unfortunately, in the papers analysed, the statistical significance of the variables is obtained mainly from cross-sectional analysis and it is hard to establish the direction of causality. Van Gameren (2010) considers the endogeneity by implementing an instrumental variable method with instruments related to the type of job. Formal employment is considered closely correlated to insurance status, not affecting CAM use. The instruments are validated through over-identification test and the bivariate probit model indicates that "the effect of insurance on the use of CAM is much larger than suggested by the uncorrected estimates".

1.4 ARE MENTAL DISORDERS ASSOCIATED WITH CAM USE?

Individuals with mental health problems use more CAM. This is outlined in 20 papers.

As far as U.S. population, Unützer et al. (2000), Astin (1998) and Honda and Jacobson (2005) find a positive association between CAM use and depression, anxiety and psychiatric disorders; however, Unützer et al. (2000) outline that the likelihood to use CAM decreases for participants with several mental disorders. In addition, Hurwitz et al. (2006) show a positive relationship between depression and chiropractic in the U.S. and a high number of mental health visits among chiropractic care seekers in Canada.

Wahlstrom et al. (2008) and Fox et al. (2010) report that anxiety and depression predicts in significant way the use of CAM among Finland and Ireland population, respectively. Similarly, anxiety and depression are significant predictors of CAM use in England (Hunt at al., 2010). As it regards the Norwegian population, the likelihood of consulting a homeopath is associated to the presence of anxiety and depression and psychiatric complaint (Steinsbekk et al., 2008). Steinsbekk et al. (2007) outline that people with psychiatric complaint are more likely to consult both a general practitioner and a CAM practitioner than those without mental illness. In addition, Steinsbekk et al. (2011) show that anxiety, depression and psychiatric complain are significantly associated with visits to CAM practitioners, in particular for females.

With reference to women samples, Astin et al. (2003) and Adams et al. (2003) highlight that mental health illness is significantly related to CAM use in Australia. Bair et al. (2002) find that emotional limits affect the use of CAM among women enrolled in the Study of Women 's Health Across the Nation (SWAM).

Regarding clinical samples, a similar trend emerges: the logistic regression conducted by Roy-Byrne et al. (2005) on a sample of patients with anxiety disorders in primary care show that CAM, in particular the use of herbal medication, is more common among patients suffering from major depression. Burstein et al. (1999) show a significant association between CAM use by women with early stage breast cancer and depression. Fang and Schinke (2007) report that, among 153 patients with mental illness, 94% had used CAM and 82% were currently using vitamin therapy, Chinese herbal medicine, massage therapy, acupuncture

and other alternative cure to treat mental health problems. In a similar way, Druss and Rosenheck (2000) show that CAM use is predicted by the presence of psychotic disorder and affective disorder; furthermore, it is outlined that "more than fourths of respondents reporting mental conditions used these therapies without the knowledge or involvement of a physician". Rossi et al. (2005) report that the number of CAM treatments used by migraine patients is significantly related to psychiatric co-morbidity; also, London et al. (2003) and Josephs et al. (2007) point out a significant association between depression and the use of alternative therapist by people in care for HIV.

Different results are reported by other studies: Bhargava et al. (2012) point out that people with an excellent or good mental health status use more acupuncture and/or massage than those reporting a fair or poor mental health conditions; Egede and Ye (2002) and Brown et al. (2009) outline that CAM use is not significantly correlated to mental health conditions; Tinga (2002) reports a non-significant association between mental health and the probability of receiving different types of CAM therapies, in fact the estimates suggest that people with better mental health are significantly less likely to use herbal remedies.

Globally, most of the literature indicates an elevated consumption of alternative treatments by individuals who suffer from mental health problems.

1.5 THE RELATIONS BETWEEN CAM USE AND HEALTH BEHAVIOURS

1.5.1 CAM use, physical activity and smoking consumption

The association between CAM use and physical activity is discussed with reference to American and Norwegian populations.

Nahin et al. (2007, 2010), Barnes et al. (2008) and Brown et al. (2009), in relation to U.S. and African American individuals, highlight that people engaged in regular exercise were more likely to use CAM than sedentary people. Among Norwegian men, visits to CAM practitioners are associated with hard physical activities (Steinsbekk et al., 2011). The results do not differ if the analysis is carried out on a sample of women. Bair et al. (2002), based on a multiethnic sample of women enrolled in the Study of Women's Health across the Nation (SWAN), point out that positive health behaviours are more prevalent among CAM users, in particular, females who do more physical activity are more likely to use CAM than those not engaged in physical activity.

These studies agree to attribute a positive relationship between CAM use and regular physical exercise.

The relationship between smoking status and alternative cure is analysed for American, Norwegian and Australian populations.

Among the U.S. individuals, Nahin et al. (2007) report that the "former smokers (40.6%) had greater odds of using CAM than persons who had never smoked (35.2%)". Similarly, Barnes et al. (2008) find that CAM use is more prevalent among formers smokers than current and never smokers. Bhargava et al. (2012) outline that the probability to use both chiropractic and acupuncture care significantly decreases for U.S. smokers. Bair et al. (2002) find that formerly smoker women were more likely to use CAM than non-current smokers. In Norwegian population the likelihood of seeking care to CAM practitioners is reduced for daily smokers as evidenced by Steinsbekk et al. (2011, 2008). Differently, a significant association between CAM use and smoker consumption is outlined by Adams et al. (2003) based on a sample of Australian women. Similarly, in Taiwan, Shih et al. (2008), who investigates the relationships

between both non-covered and covered alternative therapies by National Health Insurance (NHI) and behavioural determinants, including smoking consumption, shows that individuals that reported unhealthy behaviours are more likely to choose non-covered alternative therapies. Furthermore, Shih et al. (2008) highlight that non-covered types of CAM are used by healthier people to prevent the onset of diseases and protect their health from unhealthy behaviours; whereas, this kind of needs are not met by Taiwan's National Health Insurance services (NHI). A significant association between smokers and visits to chiropractor is outlined by Hurwitz et al. (2006) for Canadian population.

Literature does not indicate clear relationships between CAM and smoke but rather suggests a dependence on the population considered; in U.S. and Norway alternative treatments are most widespread among former and non-current smokers, while in Canada and Taiwan smoker consumption is positively related to CAM use.

1.5.2 CAM use, alcohol consumption and nutrition

Only five studies discuss the relationship between alcohol consumption and alternative cure. In addition the results are controversial: some papers associate CAM use with a lower alcohol consumption, others argue that heavier and moderate drinkers use more alternative therapies.

A higher use of CAM among U.S. population is reported by infrequent drinkers compared to heavy drinkers (Nahin et al., 2007). Wahlström et al. (2008) outline a negative association between alcohol abuse and CAM use for individuals with mental disorders. Differently, Shih et al. (2008) outline that unhealthy behaviours, such as alcohol consumption, lead to greater use of CAM therapies in Taiwan. In a similar way, a significant association between CAM use and alcohol consumers are outlined by Adams et al. (2003) for Australian women. Furthermore, another paper based on the Australian population points out a positive and significant association between CAM use and individuals that report a high alcohol intake (MacLenann et al., 1996). Among U.S. populations, a positive relationship between a greater CAM use and current moderate/heavier alcohol consumption is found by Barnes et al. (2008).

One study focused on the relationship between CAM use and diet among general population. Hunt et al. (2010) highlight that CAM use, among English population, is significantly related to the consumption of five or more portions of fruits and vegetables every day.

To sum up, few studies evaluate the use of CAM as an aspect of a wellness lifestyle; globally, they show a positive association between CAM use, physical activity and healthy eating habits. Regarding the relationships between CAM and alcohol and smoking habits, the evidence is mixed and does not allow carrying out definitive considerations.

1.6 CAM AND TRADITIONAL MEDICINE: COMPLEMENTS OR SUBSTITUTES?

In many papers of Tab. 1 it was asked to the respondents whether the use of alternative medicine was associated or not to traditional cure: 15 out of 19 studies point out that alternative and traditional therapies are jointly used.

According to Thomas and Coleman (2004), 10% of adults in Britain consulted at least one CAM practitioner in the past 12 months and the most common reason to use CAM (62%) is to treat an illness for the care of which respondents had turned first to traditional medicine; only 17% of respondents used directly CAM therapies. Brown et al. (2009) outline that African Americans use CAM as a supplement to conventional medicine. Tinga (2002), Ni et al. (2002) and Nahin et al. (2010) highlight that most of alternative therapies are used by U.S. population in conjunction with conventional medical services, while small percentages (1.7-4.4%) of U.S. population only use alternative medicine. Hurwitz et al. (2006) show that most of chiropractic patients also use primary care medical doctor, although "3.5 million chiropractic patients in the U.S. and almost 400,000 in Canada did not seek care from general or family practitioner". Adams et al. (2003) outline that women in Australia do not use CAM to substitute conventional treatment; on the contrary, they consult a lot of specialists and use also hospital services to try solving their health problems. Blais et al. (1996) show that, over a period of one year ”users of alternative medicine made fewer visits than non-users to general practitioner, but not significantly fewer visits to specialist” and CAM substitutes traditional care only when the health problems are not as serious as to require consulting specialized physicians.

Results are similar for clinical population. Wahlstrom et al. (2008) report that among people suffering of mental disorders, only few persons reported to use exclusively CAM for their care. Unützer et al. (2000) show that users of CAM suffering of mental disorders used at least one of conventional mental health services. Similarly, Egede and Ye (2002) point out that the most relevant implication of his study is that "individuals with diabetes seem to use CAM as a complement rather than as an alternative to conventional treatment". Similarly, Rossi et al. (2005) point out that migraine patients use both conventional and CAM therapies;

Richardson et al. (2000) outline two thirds of cancer patients, who were receiving chemotherapy and radiotherapy, also used vitamins and herbs. Finally, London et al. (2003) and Josephs et al. (2007) outline that some people receiving care for HIV also receive care from alternative providers.

All the above studies suggest that alternative and traditional medicines are used in a complementary way.

On the other hand, relevant economic considerations emerge for alternative medicine considered as a substitute to traditional cure. Van Gameren (2010) finds, for poor household, a negative effect of health insurance on the use of alternative therapies; it entails that the higher the health insurance coverage, the lower the price of conventional health services and the lower is the CAM use. This suggests that alternative and traditional medicine might be substitutes for some poor households. On the contrary, for rich households the effect is insignificant. Thus, conventional medicine and CAM are assumed as complementary therapies by rich households. Barnes et al. (2008) and Wu et al. (2007) outline that a greater CAM use is associated with the inability to afford conventional medical care. As well, Nahin et al. (2010) highlight that some individuals used only CAM therapies because conventional care was believed too expensive. Similarly, Graham et al. (2005) report that Hispanics were more likely to use alternative medicine when "conventional medical treatments were too expensive". Richardson et al. (2000) find that CAM use is significantly related to an indigent pay status.

The latter results outline that the CAM is considered a substitute of conventional care when the cost of traditional treatments is a worry.

1.7 REASONS AND SATISFACTION FOR CAM THERAPIES

The reasons for CAM use were explicitly asked in 16 studies. The most common motivations are: to preserve the overall health, to find relief from specific diseases and to try something that may work; even dissatisfaction about the cost and quality of traditional care has emerged as a reason for using alternative therapies.

Thomas and Coleman (2004) report that the most common reason to use CAM is to treat a specific illness, while 34% of respondents used CAM to obtain an improvement of the general health; only few people (6.5%), used alternative treatments for aesthetics purposes. The youngers use CAM to make stronger immune system, while the olders to find relief from pain (Meclennan et al., 2006). Disease prevention, health promotion and also treatment of medical problems are some reasons for using CAM (Ock et al., 2008). Graham et al. (2005) show that one third of all the respondents report that "CAM with conventional medical treatments would help". Shih et al. (2008) outline that users of non-covered CAM did not report negative experience towards orthodox medicine although they affirm that there were some problems not adequately treated within insurance system; in particular, non-covered CAM was mainly used to improve health conditions especially in case of bodily pain rather than to preserve general health. Astin (1998) finds that the main reasons for using CAM are: the perceived benefits for symptoms (respondents claimed that the treatment worked better than standard medicine); and the capacity of CAM to promote general health rather than just focus on illness. Nahin et al. (2010) report that respondents used CAM because they "thought it would be interesting to try"; in addition, 20% of people using only alternative cure believed that conventional treatments were too expensive or would not work. Oldendick et al. (2000) show that 47% of respondents used CAM to preserve general health, while chiropractor treatments were used to treat a specific health problem (87.7%). Rafferty et al. (2002) find that 24.4% of CAM users had used alternative therapies to treat a disease, 6.8% to prevent a disease and 45.5% to preserve general health. The perceived barriers to obtain care is a significant predictor reports by Ritchie et al. (2005), while dissatisfaction with the quality of care given by provider is not among the reasons that influence the CAM use. On the contrary, Hurwitz et al. (2006) show that the users of chiropractic therapists are likely to be

dissatisfied of traditional care in Canada; the authors also show that chiropractic users are dissatisfied with health care in U.S.

About clinical samples, Artus et al. (2007) based on musculoskeletal patients, point out that the most common reasons to use at least one CAM therapy were “to try anything that may work” (53%). Dissatisfaction with the cost of treatment and waiting time are the reasons for using CAM among patients with chronic diseases; on the contrary, individuals satisfied with the benefits of traditional treatments used less CAM therapies (Lee et al., 2004). Among cancer patients, Richardson et al. (2000) point out that the most common reasons to use CAM are to improve the life quality (76.7%), boost immune system (71.1%) or relieve symptoms (44%); surprisingly, 37.5% of cancer patients use CAM therapies to cure their disease, although the patients' expectations change according to the stage of disease at the time of admission. Similarly, Molassiotis et al. (2005) report that the main reasons for using CAM was to increase the ability to fight cancer and improve emotional well-being.
About women with depression, Wu et al. (2007) report that 45% used CAM for the unpleasant side effects of conventional medical treatment, 43% because of inefficacy of conventional treatment they used, 33% because the doctor had advised them to use CAM and 17% because “they could not afford conventional medical treatment”. Finally, Rossi et al. (2005) outline that the most of migraine patients used CAM because "believed in the potential benefits and safety of those treatments, not because they were dissatisfied with conventional medicine".

With regard to the perceived helpfulness of CAM, a positive experience with alternative medicine is globally shown. Oldendick et al. (2000) find that 63.3% of users were satisfied about the effectiveness of any CAM treatment; in particular, the most satisfied were respondents who had used healing therapies (79.3%), relaxation techniques (64.1%), personal therapies including herbal medicines, homeopathy or vitamin therapy (62%). Rossi et al. (2005) report that 39.5% of users perceived CAM therapies as beneficial. Rafferty et al. (2002) point out that "the majority of CAM users appeared satisfied with these therapies, finding all of them helpful (83.2%), or at least some of them helpful (5.8%)". Barbadoro et al. (2011) outline that most of CAM users with one chronic condition reported to be completely

satisfied: 77.5% for manual treatments, 68.7% for homeopathy, followed by herbal medicine (67.2%) and acupuncture (59.6%). In addition, the multivariate analysis shows that "refusing to use conventional medicine in combination with CAM was the strongest determinant of complete satisfaction for homeopathy and herbal medicine". Artus et al. (2007) report that "osteopathy, relaxation, aromatherapy had the highest median helpfulness scores"; however, some CAM users reported harmful events. Molassiotis et al. (2005) point out that only 22.4% of cancer patients found CAM helpful to fight cancer, while 42.5% found CAM useful to improve emotional well-being. Remarkably, 4.4% reported side-effect: this finding is important because outlines that some CAM therapies are not tested.

1.8 PROFILE OF CAM USERS

1.8.1 Gender and age

A positive association between use of CAM and female gender is shown by most of the papers reviewed. In particular, 20 multivariate analysis confirm that women are more likely to use CAM in Taiwan (Shih et al., 2008), United States (Bhargava et al., 2012; Barnes et al, 2008; Nahin et al., 2007; Honda and Jacobson, 2005; Ni et al., 2002; McFarland et al., 2002; Unützer, 2000; Tinga, 2002; Richardson et al., 2000, Rafferty et al., 2002; Druss and Rosenheck, 2000), Australia (Mclennan et al., 2002; Xue, 2007), Norway (Steinbekk et al, 2007, 2008 and 2011), Canada (McFarland et.al, 2002), in the Scandinavian countries (Hanssen et al., 2005) and in England (Hunt et al., 2010). On the contrary, no statistically significant association emerges from the papers of McEachrane (2006), Rossi (2005), Roy-Byrne (2005), Josephs (2007) and London (2003) between CAM use and gender: this result might be due to the specific characteristics of the sample consisting respectively of oncology, chronic pain, mental sufferers and individuals with HIV. Also Thomas and Coleman (2004) and Astin (1998) report that men and women used alternative therapies in similar proportions. No statistically significant is the relationship between CAM use and gender reported by Hsiao (2006) among Asians, American Indians and Latinos. In addition, Fox (2010), Blais et al. (1996) and Oldendick (2000) suggest that gender does not influence significantly the CAM use.

Regarding the association between age and CAM use, several papers (Oldendick et al., 2000; Blais et al, 1996; Fox et al., 2010; Barnes et al., 2008; Steinsbekk et al., 2008, Maclenann et al. 1996, 2002, 2006; Unützer et al., 2000; Xue et al., 2007; Brown et al., 2009; Hanssen et al., 2005) report that middle-age individuals are more likely using alternative therapies. In a analogous way, Adams et al. (2003) show that mid-age woman are turning to alternative therapies more than their younger or older counterparts. Similarly, Shih et al. (2008) find that females and middle age people are positively associated with non – covered CAM use, while gender is not significant to predict the use of covered CAM. Hsiao et al. (2006) report that middle age

African-Americans and Asians are more likely to use ethnic-specific CAM, but age groups are not a significant predictor for American Indians, Whites and Latinos. It is interesting noting that Steinsbekk et al. (2007), based on a comparative population health survey in central Norway, find that "CAM only users" are more likely to be male and aged between 30 and 69 rather than to be only using a General Practitioner (GP). On the contrary, when the authors compare the users of both GP and CAM with GP only users, the results are similar to those reported by other papers: highly educated women and aged between 30 and 59 are positively associated with the probability to use both alternative and traditional therapies.
Burstein et al. (1999) in a study based on 480 female patients with newly diagnosed early-stage breast cancer in Massachusetts, report a significant association between younger age and CAM use. Finally, a significant relationship between female gender, older people and current CAM use is reported in a study on a sample of Chinese Americans with mental illness (Fang and Schinke, 2007).

1.8.2 Education, income and work status

The relationship between education and CAM use is evident in almost all the papers included in the review: the higher the educational level, the larger the use of CAM. Few statistical analysis propose a non-significant association between the level of education and the use of alternative therapies (Steinsbekk et al., 2008, 2011; Shih et al., 2008; London et al., 2003, Fang and Schinke, 2007; Ritchie et al., 2005; Rossi et al., 2005). In particular, Shih et al. (2008) show that high education is positively associated with non – covered CAM use, while education is not significant to predict the use of covered CAM. Hsiao (2006) outlines that among American Indians, more education is associated with American Indian-specific CAM use, but the relationship with education for other ethnic groups is not statistically significant. In addition Roy-Byrne et al. (2005) and Druss and Rosenheck (2000) confirm the positive association between the use of alternative remedies and high education among respondents with mental conditions.

Regarding the income status, 16 out of 32 studies about this aspect, show a positive association between CAM use and higher levels of income. The papers of Maclenann et al. (1996, 2002, 2006), Ock et al. (2008), Barnes et al. (2008) and Graham et al. (2005) suggest that higher income is positively and significantly associated with CAM use. In the same way, Thomas and Coleman (2004) show a positive association between CAM use and high gross income levels. McEachrane et al. (2006), in their paper based on veterans attending oncology and chronic pain clinics at the Jamaica Plain campus of the VA Boston Health care System, show a significant association between high income and CAM.

As far as the employment status, 13 of the 18 studies analysed outline a significant relationship between use of alternative medicine and work status: the results of Blais et al. (1996) and Xue et al. (2007) suggest that employed individuals consume more alternative medicines. Similarly, Wu et al. (2007) and Fang and Schinke (2007), based on sample of individuals with mental illness, report that CAM use is significantly associated with employed status. A different result is only reported by Ock et al. (2008), who highlight that not employed people are more likely using alternative therapies in South Korea.

1.8.3 Marital status

The association between CAM use and marital status is significant for 10 out of 26 studies analysed. Wu et al. (2007) report that the unmarried women are more likely to use CAM than the married ones.

Steinsbekk et al. (2011) highlight that, among the male population, being widowed is significantly correlated to visits to CAM practitioners, while the likelihood to use CAM decreases for single males; marital status does not influence significantly the visits to CAM practitioners for women. Differently, Steinsbekk et al. (2008), in their study based on population in Central Norway, report that the probability of consulting a homeopath decreases for widowed individuals. Also Barnes et al. (2008) show, among US adults, that widowed people are less likely to use alternative medicine.

Wahlstrom et al. (2008) and Ock et al. (2008) suggest that being married affects positively the probability of CAM use. Also Bhargava et al. (2012) find that in US population, the probability of chiropractic use is affected significantly by marital status, in particular married individuals are more likely to use chiropractic than widowed; on the contrary, the acupuncture use is more likely between divorced/separated people (but the marginal effect is not statistically significant).

A significant association between CAM use and being formerly married is reported by Tinga (2002). In a similar way, Oldendick et al. (2000) report that, among South Carolina adults, "divorced or separated respondents were significantly more likely to report CAM use than married, widowed or single respondents". A different result is found by MacLennan et al. (2006), who suggest that separated and divorced individuals are less likely than married people to use CAM therapies in South Australia population.

Globally, it seems emerging that married individuals use more alternative medicine than separated and widowed people.

1.8.4 Ethnicity and residence area

Most of the papers (75 %) show a significant association between CAM use and ethnicity; in particular, it emerges that Whites are more likely use CAM than individuals of another race. Bhargava et al. (2012) report that non-Hispanic Whites, compared to Hispanic, are more likely to use both chiropractic that acupuncture, while non-Hispanic Blacks are less likely to use these alternative therapies. Similarly, Johnson et al. (2011) show that being non-hispanic White is significantly correlated to CAM use. In addition, Tinga (2002) reports that white people are more likely to use CAM than African Americans and Asians. Similarly, Rafferty et al. (2002) find that the use of CAM is more prevalent among Whites than Blacks in Michigan. Upchurch et al. (2005) point out that White women living in the West are more likely to use CAM than Black, Hispanic and Asian people; the Authors suppose that this result is related to a greater predisposition of White women to try CAM therapies or because ethnic minorities could use remedies coming from their particular traditions. Bair et al. (2002) show the Whites use more alternative medicine that African American, Japanese and Chinese

people.

Also the residence area is significantly correlated to the CAM use as reported by several studies reviewed; Tinga (2002), Ni et al. (2002), Barnes et al. (2008), Druss and Rosenheck (2000), Unutzer et al. (2000), Graham et al. (2005), Johnson et al. (2011) and London et al. (2003) outline that living in the West of the U.S. is a factor significantly and positively associated with CAM use. In addition, Bhargava et al. (2012) show that the region of residence affects the use of alternative medicine in U.S., which is more used in the West than in the Northeast and Midwest.

1.8.5 Health Status

Health conditions and CAM use are closely related: 84,1 % of the studies dealing with this aspect find a significant association between CAM use and poor health conditions.

Bhargava et al. (2012) report that the likelihood of using chiropractic is higher for individuals with asthma, back and/or musculoskeletal problem than for individuals with hypertension problems.

As well, the use of acupuncture is positive associated with back and musculoskeletal problems. A significant relationship between a frequent CAM use and back or neck problems is also reported by Wolsko et al. (2002), Astin (1998), Tinga (2002) and Ock et al. (2008) that outline a positive association between having poorer overall health and CAM use. The presence of pain is also associated with CAM use in the Irish population and among African Americans, as reported by Fox et al. (2010) and Brown et al. (2009), respectively. A similar result is suggested by Upchurch et al. (2005): women with poorer health status have higher probability to use CAM than those in excellent health. Also Hanssen et al. (2005) find a significant and positive relationship between CAM use and poor self-reported health in the Scandinavian Countries.

Steinsbekk et al. (2008) suggest that the probability to use CAM is higher for people with poorer global health compared to very good global health. However, the paper in which

Steinsbekk et al. (2007) compare the profiles of people visiting only a CAM practitioner, those visiting only General Practitioner and those using both, suggests that serious health problems such as cardiovascular disease reduce the probability of using CAM compared to use a General Practitioner. A similar result is reported in Steinsbekk et al. (2011), who outline that the presence of heart disease is negatively associated with visits to CAM practitioner for males in 2008. Hurwitz et al. (2006) outline that individuals who use chiropractic are more likely, than general practitioners patients, to suffer from arthritis and back or neck pain in Canada and U.S.

Nahin et al. (2007) report that individuals, who perform physical activity, with a healthy body-mass index and following other healthy behaviours (not current smokers and heavy drinkers) are more likely to use CAM, independent of their health status. In an analogous way, Bair et al. (2002) based on female sample, report that CAM users who have more positive health behaviours than non-users, play more physical activities and are less current smokers. In addition, CAM users suffer less of depression but have a poorer health-related quality of life than non-users because of bodily pain and physical limits. Also Brown et al. (2009) outline that CAM users report more limitations in daily living activities than non-users.

Hsiao et al. (2006) show that patients with chronic illness and cancer are more likely to use ethnic-specific CAM across all ethnicities considered in the survey (i.e. Asian, African, American Indians, Latinos, Whites). A positive and significant relationship between a high number of health problems and CAM usage is also found by Barnes et al. (2008).

Lee et al. (2004), based on a sample of 488 adult patients with chronic disease, report that CAM use is predicted by the presence of specific health problems: arthritis, musculoskeletal disorders and stroke. Most of the studies suggest that individuals with greater health problems, in particular due to chronic conditions, use more alternative medicine than those who report a better health condition.

1.9 DISCUSSION

The results of this study should be considered with some limitations: the 56 papers included in this review differ for the reference population, methodology, for a non-unique definition of the therapies included in the CAM and because many measures are self-reported. Nevertheless, the deficiencies of the current literature are outlined and useful considerations emerge.

Table 1.2 reports, for any variable considered, the number of papers in which the variable is included (in some papers each variable is analysed for two or more sub-samples) and the percentage of the articles for which the variable appears statistically significant.

Table 1.2. Statistical significance of the variables on the CAM use.

Variables	Total articles	% statistically significant
Gender	52	73.1%
Age	59	66.1%
Race	25	60.0%
Area of Residence	30	80.0%
Marital Status	26	38.5%
Education	55	83.6%
Employment	18	77.8%
Income	32	50.0%
Health Public Insurance	27	40.7%
Health Private Insurance	8	62.5%
Poor Health Condition	44	84.1%
Mental Condition	29	75.9%
Physical Activity	10	100.0%
Smoking	12	91.7%
Alcohol	7	100.0%
Diet	1	100.0%

First, 62,5% of the studies, dealing with the relationship between CAM use and private insurance, shows that individuals with private health insurance for CAM make extensive use of alternative medicine, probably because the full or partial reimbursement of insurance companies encourages opportunistic behaviours. Thus, problems of adverse selection and

moral hazard characterize the private insurance coverage for CAM. Both problems are caused by asymmetric information; while the adverse selection problem may be solved by a universal and compulsory public insurance coverage, moral hazard leads to market distortions hard to control. On the other hand, the presence of a private market for coverage of alternative therapies creates inequities of access to alternative therapies in favour of the wealthiest individuals.

The importance to distinguish between self-selection or moral hazard for public policy decisions encourages distinct studies about the insurance endogeneity in health market sector: from randomization of the insurance type (Manning et al., 1987) to the use of instrumental variables (i.e. Cameron et al. 1988), up to recent attempts such as those of Coulson et al. (1995) and Bajari et al. (2006) who applied, respectively, a non-linear two stage and a two- step semi-parametric model to obtain unbiased estimates of moral hazard. In addition, Chiappori et al. (1998), based on controlled natural experiment, excluded any self-selection effect and estimated a moderate effect of the change in relative price on the demand of GP visits; Barros et al. (2008), - using a matching estimator (Abadie and Imbens, 2006) found a positive large impact of additional coverage on demand of care.

On the contrary, the current empirical evidence on CAM demand, excepted for Van Gameren (2010), does not focus on the distinction between moral hazard and self-selection: this important issue deserves attention from future researchers as it is necessary to understand if and how the demand for alternative treatments reacts to price. Presumably, the demand for alternative therapies based on visits to the physicians, will be less responsive to the terms of insurance because, generally, when non-monetary cost are high, the demand is more inelastic (Chiappori et al., 1998; Barros et al., 2008).

Secondly, a strong association emerges between CAM use and mental disorders; the frequent use of relaxing and herbal remedies by individuals reporting depression, anxiety, panic disorders suggests that mental problems are under-diagnosed and under-treated by mainstream medicine. Furthermore, the studies show that alternative and traditional remedies for mental illness are used in conjunction and the physicians do not know that their patients are also using CAM. The inclusion of CAM among public insurance coverage may facilitate the control, by health practitioners, of the use of simultaneous medicines thus

avoiding potential side-effects. However, it is worth noting that the papers reviewed do not discuss how an extension of insurance coverage for mental illness may cause an overuse of CAM because of moral hazard. As reported in the literature (Frank and McGuire, 1986; Landerman et al., 1994), the demand for mental health care is more sensitive to price than the demand for general cure. It is hoped that future empirical studies on CAM will be able to assess the effect of moral hazard towards adverse selection because the efficacy over placebo of alternative therapies for psychiatric condition is not universally demonstrated and the risk of wasting resources is particularly high.

Regarding the studies assessing the relations between CAM and lifestyles, they show several limitations. First, statistical analysis are performed on cross sectional data and thus, the direction of causality - whether people adopt a healthy lifestyle and then use alternative therapies as a part of health behaviours or if CAM use promotes modifications in health beliefs or behaviours - cannot be assessed. Secondly, the logit model used to estimate the correlations between the use of CAM and lifestyles may not be the most appropriate econometric method if some omitted variables were related to both the dependent variable and lifestyle variables. In this case, the estimates may be distorted and lead to wrong conclusions on the relationship between CAM and health behaviours.

About the relationships between traditional and alternative medicine, several papers report that the therapies are jointly used by the majority of the respondents. The outcomes of this thesis also outline the existence of side effects from a combined use of distinct medicines to be taken into account to safeguard the health of consumers and avoid an increase in the costs of health care. In addition, the use of alternative therapies as substitute of the traditional cure by the poorest individuals emphasizes inequities and inefficiencies in the redistributive policies and should suggest politicians to organize a health system able to allow the lower classes to use the safest traditional treatments.

As far as the reasons for turning to CAM, it is mostly used for general health improvement, immune system strengthening and relief from pain: alternative treatments may be introduced among public insurance coverage for preventive health care and for treating, in particular, chronic health conditions. Besides, conventional treatments not useful and

barriers to obtain care are other reasons that lead to use CAM. These results outline the need to make a better use of the existing resources to avoid shifting demand towards still untested alternative therapies. The majority of people who use the CAM are satisfied, even if there are sporadic cases of side effects.

Finally, besides the main topics, the profile of CAM user is defined, not differing so much from that outlined by other surveys: most users of CAM are female, middle age, well-educated, employed, affluent, White and with poorer health than non-users.

2 THE RELATIONSHIPS BETWEEN CAM USE AND HEALTH-RELATED BEHAVIOURS IN ITALY AND ENGLAND

2.1 INTRODUCTION

Individuals with poor health habits can impose costs on the others; some of these costs are defined as “internal”, because they are incurred by people with unhealthy habits (and their family). Other costs are "external" because they refer to the cost that smokers, heavy drinkers and inactive people impose on non-smokers, abstainers or moderate drinkers and on those who exercise regularly. Certainly, a relevant part of the external costs are made up by the financial cost of health care; in particular, health care costs include, in addition to traditional medical services, also unconventional forms of therapies. It is important to outline that, in many Countries, such as England, Germany, Taiwan and recently also in some regions of Italy, some alternative therapies, whose effectiveness and safety has been proven, are covered by the National Health Service as well as by private health insurance .

The growth of the health care costs led scientists and researchers to analyse with an increasing attention the relationship between lifestyles and medical care. In particular, a lot of research has been done on the medical costs of smoking, less on the costs of drinking, while the analysis of the external costs of inactive people has been developed only in relatively recent times. Differently, the relationships between unconventional care and lifestyles is lacking in the health economics literature, not withstanding e the widespread use of CAM among individuals, as already mentioned in the first chapter.

This chapter, starting from the review of the economics literature about the relation between traditional medical services and health behaviours, will try to assess the causative relationships between CAM and healthy behaviours among the Italian and English

populations. This topic is relevant for many reasons. Firstly, according to Grossman's model (1972), the demand for health care is affected not only by the demand for medical care, but also by health behaviours. In particular, the theoretical model indicates the medical care as an input of health production function, but the widespread use of homeopathy, manual treatments, herbal medicines and other unconventional treatments makes important to investigate if individual behaviours have significant effect also on the use of unconventional therapies and, eventually, the sign of the relationship. The study of the relation between CAM and healthy habits will allow learning more about the overall effects of non medical inputs - lifestyles - on both traditional and unconventional medical inputs. In particular, a positive effect of healthy lifestyles on CAM would suggest that, notwithstanding the adoption of healthy behaviours, people use more unconventional medical services. A possible explanation could arise from the use of CAM as a complement to an active and healthy lifestyle and alternative therapies may also be used as part of preventive medical care services. On the contrary, a negative effect of healthy behaviours on CAM would suggest that the adoption of healthy lifestyles reduce the healthcare utilization, similarly to the effect of lifestyles on traditional medical care. In addition, the coverage of some non-conventional treatments by National Health Service means allocating additional funds for the public health and therefore the knowledge of specific patterns between CAM use and health behaviours may contribute delineating health promotion programs and guiding the work of the CAM practitioners and policy makers.

In the next paragraphs, the papers, which focus on the relationship between medical care and health habits, are reviewed; particular emphasis is given to the methodology used and the main limitation of the estimates.

2.2 HEALTH BEHAVIOURS AND MEDICAL CARE: LITERATURE REVIEW

2.2.1 Medical care and physical activity

Physical activity is included as an input in the health production models; in particular, physical active individuals are expected to use less healthcare services than inactive individuals. The main studies discussing the relationship between medical care and physical activity are analysed hereafter.

An estimate of the costs of sedentary lifestyle is carried out in the U.S. by Keeler et al. (1989), who use data from the National Health Interview Survey (NHIS) and the RAND Health Insurance Experiment (HIE). The authors, to estimate the cost associated with a reduced physical activity, make use of a hypothetical person: the "active inactive individual". In other words, they consider hypothetical cohorts of sedentary men and women who are made physically active in order to build a counterfactual group. In this way, the effects of other differences between active and inactive people are held constant in the regression equation, because the only variable that change is the "exercise variable". The authors believe important including in the regression analysis, in addition to socio-economic variables, general and mental health indices and chronic diseases to limit the possibility that the health status could influence the physical activity. The estimates of the multiple regression analysis carried out on HIE sample, outline that individuals doing strenuous exercise have a 20% lower hospitalization rate and use 6% less outpatient care than those doing light or never exercise. The effect of moderate physical activity has a positive effect also on the medical costs, in fact the estimates show a reduction of 12% in outpatient use for moderate exercisers compared to never or light exercisers. The effect of a physically active lifestyle on the reduction of medical care is also highlight for the NHIS sample. Thus, the paper by Keeler et al. (1989) points out that if sedentary people become more physically active, the use of the medical services and the cost associated would be reduced. Similarly, Manning et al. (1991) analyse how exercise relates to the use of health care, using the data of both HIE and NHIS in 1983. As in Keeler et al. (1989), the authors add general and mental health indices and the count of the number of chronic conditions into the multiple regression analysis to control for the possibility that health status may influence participation to exercise. The results outline a

significant effect of the lack of exercise only for NHIS sample:"people who reported exercising less than average for their age group had 39% more office visits and 52% more hospitalizations than those who exercised more than average".

An important limitation of these studies arises from the degree of causality between physical activity and health status. In fact, although the authors exclude physically limited people and include some covariates to control for the heath conditions and chronic diseases between exercisers and non-exercisers, the relationship between physical activity and health-related costs may not be completely causal.

The relationship between lifestyle and the use of hospital care is examined for general population in Finland through a 16-year follow-up study performed by Haapanen et al. (1999). The authors use a negative binomial model to account for the skewed distributions of the hospital days. The estimates show that sedentary men and women have, respectively, 36% and 23% more hospital days than those physically active. Different results are outlined with regard to the hospital days caused by injuries and accidents: men and women moderately active have 94% and 56% fewer hospital admissions due to injuries than the most active people.

The risk of disease and the subsequent direct health care costs of physical inactivity are also estimated in Canada by Katzmarzyk and Janssen (2004) through a meta-analysis of the existing studies. Firstly, the authors consider the specific diseases known to be associated with physical inactivity from a review of the literature. The chronic diseases that are associated with sedentary lifestyle are coronary artery disease, stroke, hypertension, colon cancer, breast cancer, type 2 diabetes and osteoporosis. Further, summary relative risk estimates (RR) are calculated using a variance-based method of meta-analysis (Petitti, 1994) and only the studies reporting a point estimate of RR as well as a 95% confidence interval are included in the analysis. Finally, the population attributable risks (PAR%) for each disease are calculated. PAR is a statistic that combines the RR of a disease due to physical inactivity with the prevalence of the sedentary people in the population; thus, it is possible obtaining the costs of that disease in the society, which are directly due to physical inactivity. The prevalence of physical inactivity is derived from the Canadian Community Health Survey.

Taking into account that direct costs of medical care (including hospital care, drug and physician expenditures, costs for care in other institutions and additional direct health

expenditures), the authors estimate that medical care costs of physical inactivity represent 1.5% of the total direct health care costs ($106.0 billion) in Canada in 2001.

The most relevant limitation of this paper is the indirect method used, i.e. the prevalence-based approach. This method does not rely on individual level information and is not possible to control for other variables that, in addition to physical activity, influence the costs of healthcare utilization, thus giving estimates likely bias.

The impact of the physical inactivity on Canadian healthcare system is also analysed by Sari (2009). Given that the dependent variable, i.e. healthcare utilization, assumes non-negative count values, the author carries out a Zero-Inflated Negative Binomial model; in this way, both the over dispersion, caused by unobservable heterogeneity, and the high proportion of zero are taken into account. The estimates show that on average, inactive individuals spend 38% more hospitalization days than active individuals, they also use more family physician visits, (5.5%), more specialist services (13%) and more nurse visits (12%) than active people.

Differently from the studies reported above, Humphres et al. (2014) investigate the association between physical activity and health status in Canada: the authors carry out a bivariate probit model to highlight that participation in physical activity reduces the reported incidence of diabetes, heart disease, asthma and arthritis. In particular, moderate exercise reduces the probability to suffer from above chronic diseases more than vigorous exercise. However, the reliability of these estimates is influenced by the validity of the exclusion restriction adopted to identify the model.

To sum up, the results of these studies outline that physical inactivity is associated with more use of medical services with a consequent increase of the costs borne by the society for the treatment of the diseases directly attributable to this habit.

2.2.2 Medical care and smoking

Smoking is a high-risk behaviour, and, although it is widely known that smoking is associated with many diseases, it continues to be widespread among the population. Estimates of the economic consequences of smoking on medical care use have been carried

out through numerous methodologies.

The first descriptive study analysing the relationship between the impact of smoking on medical care is by Luce and Schweitzer (1978). They estimate that medical costs caused by smoking habit account for 7.8% of direct medical expenditures in the U.S. in 1976. To obtain this result, firstly, the authors use epidemiological findings from a panel of experts to know the proportion of each disease caused by smoking habit ("smoking factor"); then, these smoking factors are applied to personal health expenditures for the major category of illness related to smoking (neoplasm, circulatory and respiratory disease).

A more accurate estimate of the direct cost attributable to smoking is carried out by Rice et al. (1986), who used data from the Smoking Supplement of the 1979 National Health Interview Survey. Differences between smokers and never smokers (as far as per-capita rates of utilization of inpatient care and physician visits) are used to estimate the proportion of the costs attributable to smoking. The authors outline that the most relevant cost among smokers are related to hospital care (69%), following by professional services and nursing home (13%) while 5% of the total cost are for drugs.

The association between smoking and total medical expenditure attributable to smoking (SAEs) is also shown for U.S. population by Miller et al. (1998) for year 1993. Firstly, the authors use a national model in order to obtain the smoking-attributable fractions (SAFs) of the total state medical expenditures for 50 States and District of Columbia. In particular, the national model is used "to estimate expected expenditures for medical care of smokers and the expected expenditures for medical care of a hypothetical group of people, i.e. smokers considered as never smokers". Thus, the authors control for health status of smokers and non-smokers, in addition to several socio-demographic, economic and behavioural factors; the differences in the expected healthcare use between the two groups may be attributable to smoking. Then, SAFs are applied to published state medical expenditures to estimate total medical costs related to cigarette smoking. The estimated proportion of total medical expenditures due to smoking for the U.S. is 11.8%; in particular, 15.9% of costs are caused by nursing home cure while home expenditures count for 8.0%.

The economic burden of smoking is also investigated in Germany (Ruff et al., 2000). The direct cost for health care utilization (the costs of ambulatory care, costs of drug treatments, hospital care, rehabilitation and long term nursing home care) are calculated with the use of

official German statistics and other countrywide databases using 1996 figures from MEDLINE, the German Institute for Medical Documentation and Information and Internet. In particular, the focus is on seven most frequent disease associated with smoking: chronic pulmonary disease, coronary artery disease, long, mouth and larynx cancer and stroke and atherosclerotic occlusive disease. The results of the study highlight that the total health care costs due to tobacco use in 1996 in Germany are 16.6 billion EURO.

The relationship between smoking and medical care among U.S population is also studied by Manning et al. (1991). The authors use the data from Health Insurance Experiment (HIE) for people younger than 60 and The National Health Interview Survey (NHIS) for information on elderly people (over 60). Firstly, multiple regression methods are carried out to estimate the effect of smoking on medical care use, controlling for the differences between smokers and never smokers not causally related to this habit. The estimated equations are used to predict the medical costs in two situations: considering their actual smoking status (former or current) or using a counterfactual group, i.e. smokers considered as never smokers. Thus, the authors compare the magnitude of medical care use between current smokers and people reporting similar characteristics but who never smoked. The results outline that former smokers have, on average, a 12% more outpatient treatments than never smokers; the difference between current and never smokers is insignificant. With regard to inpatient treatments, current cigarette smokers have 38% more hospitalization than never smokers, while not statistically significant is the difference between former and never smokers. Similarly, the estimates point out that people who smoke a pipe or cigar have higher inpatient and outpatient care than never smokers. Furthermore, the results do not differ when the estimation is based on NHIS sample: current and former smokers have higher inpatient admission rates (19% and 31%) than never smokers, while outpatient visits are significantly higher for former smokers compared with never smokers.

Haapanen et al. (1999) perform a negative binomial regression analysis to explore the associations between lifestyles and the use of private or public hospital care between March, 1980 and December, 1995 in Finland. The authors highlight that both current male and female smokers have much more hospital days related to cardiovascular diseases than never smokers (173% and 461%, respectively). This result agrees with the findings by Manning et al. (1991) notwithstanding the different methodologies used for the analysis.

The impact of smoking habit on medical care use is examined by Izumi et al. (2001) in Japan. The study is based on beneficiaries of National Health Insurance, in 1994, 40-79 years aged and a multiple logistic regression analysis is carried out to analyse the association between medical care and smoking. The results show that the hospitalization days are significantly higher for smokers than never smokers: 33% higher for males and 8% higher for females. On the other hand, physician visits tend to be lower among smokers. However, the difference in the outpatient costs is not significant. According to the authors, the higher costs of the medical care among smokers are also due to a lack of appropriate treatments in the early stages of diseases.

Finally, it is important to point out the most relevant limitations of the studies discussing the association between the use of medical care and smoking habit. The papers based on Smoking Attributable risk Fraction (SAF) suppose that this indicator captures the true health care demand for the diseases causally linked to cigarette smoking. This assumption may be too strong because smoking behaviour may be offset by a different consumption of health services by smoking people. Furthermore, even the estimates based on econometric models may be biased. In fact, although the authors use multiple regression methods to control for several observable characteristics that influence the use of medical care, other unobservable factors, such as personality, socioeconomic status and health status could affect healthcare use between the groups of smokers and non-smokers, thus making hard to capture the causal relationship between medical care and smoking habit.

2.2.3 Medical care and alcohol

The literature about the relationship between medical care and alcohol consumption is much less extended than the literature on the effect of smoking and physical activity on medical care use. Firstly, it is difficult distinguishing between drinkers and non-drinkers as well as considering the amount of alcohol consumption that can be considered dangerous for the individual health. For this reason, in some studies the drinkers are firstly divided in categories and then the association between medical care use and alcohol is assessed.

The first paper is by Berry et al. (1977) who estimated the health care cost due to alcohol abuse in 1971. The authors use a population-specific approach: the health care utilization of alcohol abusers is compared to the health care use of non-abusers and any difference is associated with the alcohol abuse. Then, an estimate of total annual health care cost associated with alcohol abuse ($22.5 billion) is obtained by multiplying the difference in per-capita medical use by an estimate of prevalence of alcohol abuse. As stated above, the strong limitation of this approach is that it may overestimate the medical care use "because it fails to correct for factors that are associated with but non caused by alcohol abuse"(Manning et al., 1991). Differently, an illness specific approach is used by Harwood et al. (1984), who updated the study by Craze et. al (1981). Firstly, the diseases associated with alcohol abuse are identified, then the estimates of the costs linked to any illness are summarized; thus, the health care cost associated to alcohol consumption are estimated to be $16.4 billion. Differently from the population specific approach, the method used in Harwood et al. (1984) may underestimate the medical care use if some diseases caused or got worse by alcohol abuse are not included in the estimates. Manning et al. (1991), in addition to study the effect of smoking and physical inactivity on the medical care on HIE and NHIS data, also highlight the effect of heavy drinkers, those who imbibe 3.0 or more ounces per day, on outpatient and inpatient use. About outpatient use, the estimates on HIE sample show that former drinkers have 33% more habit-related episodes than light drinkers (those reporting a monthly consumption of 1.0 ounce of ethanol); furthermore, heavy drinkers have a significantly higher number of hospitalizations than light drinkers. The estimates on NHIS sample report that formers drinkers have 15% fewer visits, but 13% more hospital admissions than infrequent drinkers. A logistic regression analysis is carried out by Peruga et al. (1989) to examine the association between alcohol consumption patterns and the use of health services among general population of the region of Madrid. The authors outline that moderate drinkers are associated with a lower likelihood to use health care service than non-drinkers. Surprisingly, excessive drinkers also show a tendency to use emergency care services less frequently. The authors highlight that these estimates may be explained by a different use of health services by moderate drinkers. Cryer et al. (1999) analyse the effect of alcohol consumption on acute and preventive medical services use in England. The authors use a linear model for ordered categorical outcomes (abstainers, safe, intermediate, harmful

drinkers) adjusting for socio-demographic variables that may affect the relationship between alcohol consumption and health. The results outline that heavy alcohol consumers use more acute medical services but significantly less preventive cure than safe limit drinkers.

To summarize, the papers dealing with the relationship between medical care and alcohol habit report an association rather than a causative relation between heavy alcohol consumption and a major use of health care. In fact, the studies suffer an uncertainty about which differences between abstainers and drinkers in the use of medical care are causally related to the alcohol consumption and which are simply associated with this habit.

2.2.4 Remarks

The papers analysed show that, on average, people not following healthy behaviours use significantly more medical services than those with healthy habits, and thus the literature suggests that the adoption of a healthy lifestyle may significantly reduce traditional medical care costs. The critical empirical challenges in estimating the relationships between medical care and health behaviours is given by unobservable individual heterogeneity and endogeneity of lifestyle variables. As evidenced by the literature review, the authors try to assess this issue using empirical methods to control for several factors that may affect the relation between medical care and habits. However, the econometric methods used do not ensure that the estimates are exempt from endogeneity problems. In particular, only the paper by Humphreys et al. (2014), who analyse the effect of physical activity on health, try to clearly address the potential endogeneity of the physical activity using a recursive bivariate probit model with exclusion restrictions (Maddala, 1983).

With regard to the causal effect of healthy diet on medical care use, the economics literature does not discuss explicitly this relationship. However, the effect of diet on health is investigated (Hakkinen et al., 2006). In particular, the authors use a recursive model to estimate the health production function and health input functions for four lifestyle variables.

Aware of the econometric challenge due to the endogenous relationship between variables

measuring health-related behaviours and medical care use, it is relevant studying the effect of individual health behaviours on unconventional therapies use.

The relationships between CAM use and healthy behaviours will be assessed considering representative sample of the Italian and English populations. In particular, the effect of regular physical activity, following an health diet and non-smoking on CAM use will be analysed for the Italian dataset whereas, the relations between CAM and active lifestyle, fruits and vegetables consumption, non-smoking and non-heavy drinkers will be assessed for the English dataset.

As it concerns the econometrics methodology, two regressions will be performed: a probit model and a recursive probit model (Maddala, 1983). The first is used to estimate an association between CAM and lifestyles, as well as to highlight some interesting determinants of CAM use. Regarding the recursive regression, as in Humphreys et al. (2014), an instrumental variable approach will be use to better identify the model and to estimate the casual effect of each healthy behaviours on CAM use.

In the next paragraphs the main aspects of the Grossman's human capital model of the demand for health will be briefly described and then, the regression models performed on Italian and English surveys will be described.

2.3 DEMAND FOR HEALTH: THE THEORETICAL MODEL

The human capital model of the demand for health, originally developed by Grossman (1972), can be considered as one of the most relevant theoretical innovations in the health economics literature. In the Grossman's approach, the individuals are supposed to inherit an initial amount of stock of health that depreciates with age and at an increasing rate; however, several acts of investment can be used to increment the health. In particular, the household production function model of consumer behaviour is employed to relate an output of health to health inputs, such as medical care, healthy diet, physical activity, cigarette smoking and alcohol consumption. Individual characteristics of the consumers influence the amount of stock of health achieved from a given amount of inputs, i.e. the efficiency of the production function. In particular, among the personal characteristics, individual's education level is supposed to cover a particular importance since it may help to produce health in a more efficient way; for example, the harmful effects of cigarette smoking or the long-term health risks of overweight are better known among the most educated people (Kenkel, 2000).

It is assumed that the consumer maximizes the following inter-temporal utility function:

$$U = U(\phi_t H_t, Z_t), \qquad t = 0,1,\ldots,n$$

where H_t is the stock of health in period t, ϕ_t is the service flow per unit stock, $h_t = \phi_t H_t$ is the total amount consumed for health services and Z_t indicates the consumption of other commodities. Death occurs when $H_t \leq H_{min}$.

As it regards the utility function, consumers produce investment in health according to the following household productions function:

$$I_t = I_t(M_t, TH_t, Z_t, e_t)$$

where M_t indicates medical care, TH_t is the time spent in health promoting activities and Z_t refers to the personal characteristics of individuals, such as level of education, which influence the efficiency of the production process. In addition, there are other unobservable factors e_t, which may affect the investments in health such as genetic endowment and risk

propensity of people.

In this study the use of CAM is considered as a potential input into the health production function; in particular, the individuals may choose to invest in both traditional medical services and alternative therapies to increase the health capital. Thus, the household production function can be better expressed as:

$$I_t = I_t\ (M_t, CAM_t\ , TH_t\ , Z_t, e_t)$$

where CAM refers to the use of non conventional treatments at the time *t*.

The relationship between CAM use and health-promoting activities such as physical activity, healthy eating habits, no smoking and no-heavy drinking will be analysed. In particular, the aim of this work is to understand whether the adoption of healthy lifestyles reduces the use of alternative cure or, otherwise, the two inputs of health production function are used together to increase the stock of health.

2.4 CAM USE AND HEALTH BEHAVIOURS IN ITALY

2.4.1 CAM in Italy

In Italy the use of alternative therapies is widespread even if its diffusion, unlike what happened in other Western Countries, is relatively recent.

Data on CAM use are collected by the Italian National Institute of Statistics (ISTAT) that periodically conducts, on a sample of Italian families representative of the population, the survey "Health conditions and use of health services" (HCS, hereafter) that allows understanding the needs of the citizens in terms of health and quality of life as well as providing information on non-conventional therapies and their usefulness.

During the period 1997-1999, 15.6% of the Italian population used during the 3 years before the interview at least one unconventional therapy; homeopathy was the most prevalent, used by 8.2% of the population, followed by manual treatments (7%), herbal medicine (4.8%) and acupuncture (2.9%). The survey related to the year 2005 outlines a reduction of CAM use; 13.6% of the population reported CAM use in the past three years, while no change was reported regarding the therapies more frequently used, with homeopathy chosen by 7.0% of the population, manual treatments used by the 6.4% of the individuals, herbal medicine and acupuncture used, respectively, by 3.7% and 1.8% of the people and other types of non-conventional therapies were chosen by 0.4% of the Italian population. With regard to the relationships between CAM use and health behaviours, a study was carried out in Tuscany region (central Italy), to evaluate the use of alternative medicine by Italian general practitioner and some lifestyles: smoking, diet and physical activity (Giannelli et al., 2007) following a vegetarian and macrobiotic diet and doing physical activity. However, no study has ever been conducted to assess an association between CAM and lifestyles among the general population in Italy, and this will be the main topic of this chapter.

2.4.2 Empirical model and identification problems

To estimate the influence of healthy lifestyles on alternative treatments the following specification of CAM use is adopted:

$$CAM_i = \alpha PA_i + \beta\ SM_i + \lambda\ SD_i + \delta Z_i + e_i \quad (1)$$

where PA_i indicates if individual is physically active, SM_i controls for the smoking status of the respondents and SD_i captures the individual's choices regarding diet (with a little salt, slimming, vegetarian, etc). Z_i is a vector of other explanatory variables, in particular it contains sex, education, age, marital status, socio-professional status, family economic resources, residence area and health conditions of the respondents; lastly, e_i is the classical error term normally distributed. The accurate description of all variables is presented in the next paragraph.

Despite the relationships between CAM and lifestyles are estimated controlling for several individual characteristics, there are some variables, for which data are not available, such as inter-temporal preference, genetic predispositions, environment conditions, risk propensity of the individuals, which may affect both CAM use and the choices about health habits. These unobserved variables are part of the error term in the estimation and the possible correlation between these variables and healthy behaviours may result in an endogeneity problem. It is relevant to account for endogeneity otherwise the estimates of the relationships between the unconventional medical care and health behaviours, two inputs of health production function, may give incorrect results and not to allow a casual interpretation of the effects of healthy behaviours on CAM use.

The studies discussing the association between alternative cure and health behaviours, use Logit model without taking into account that unobserved variables could be related both to the CAM use and lifestyles, generating potentially biased estimates.

The goal of the next paragraphs is to estimate, through a Probit model, an association between CAM use and healthy behaviours, also indicating the factors associated to CAM use among the Italian population. Afterwards, the potential endogeneity problem will be managed using a recursive probit model (Maddala 1983; Greene, 1988), i.e. a simultaneous equations model that leads to unbiased estimates of causal relationship between CAM use and health behaviours (Greene, 1988; McClellan, 2003).

2.4.3 Data description and variables used for the econometric analysis

The survey "Health Conditions and Recourse to Healthcare Service" for the year 2005 (ISTAT, 2005) and, in particular, the "file A" - including region and geographical code - is used to analyze the relationship between CAM use and health-related behaviours for the Italian population. The sample consists of 60,000 randomly selected families interviewed during four periods, December 2004, March, June and September 2005. First, a self-administered questionnaire was completed by each individual and then a face-to-face interview was conducted by a ISTAT data collector.

An individual is considered a CAM user if he/she has used, during the past three before the interview, at least one of the following non-conventional therapies: acupuncture, homeopathy, fitoteraphy, manual treatment and others non-conventional treatments.

Three indicators of lifestyles are considered: physical activity, smoking consumption and special diet.

The variable "physical activity" is expressed by a binary indicator that takes the value one if the respondent performs light and/or moderate and/or vigorous physical activity for at least twenty minutes and practiced at least three times per week during leisure time, zero if he/she does not do any type of exercise. Similarly, "special diet" is also a binary variable that has value 1 whether the respondent follows a special diet, such as with low salt, vegetarian regime, slimming, 0 otherwise. Lastly, the variable non-smoker is a binary variable that takes values 1 if the respondent does not smoke, 0 if he/she currently smokes.

The independent variables can be divided in four categories; the first include predisposing factors like gender, age, family status, body mass index and the frequency with which the respondent controls the body weight. In particular, in addition to the variable age, indicating the age of the respondents, its square is calculated to capture any non-linearity and better control for the depreciation of health consequent to advancing age and that may have an impact on the lifestyles adopted by people. Marital status is captured with four binary variables (single, married, divorced /separated, and widowed); furthermore, a variable that takes value one, when individual has a baby, is included. A second group of variables controls for the social and economic conditions of the individuals: to capture the overall economic status of the family in the past twelve months, four binary variables indicate if the

self-reported family economic status is excellent, fair, insufficient or absolutely insufficient, and five variables control for the tenure status of the house. In addition, a variable indicating if the individuals live in villa is included in the estimates. To better control the economic conditions of the respondents, thirteen binary variables, related to the sector of economic activity of employed and non-employed but who have worked in the past, are added.

The level of education is expressed by binary variables that indicate if individuals are illiterate, have a primary, lower high school, university or PhD certificate. Binary variables indicating the type of work are used to control for the social class of the respondents, in particular, individuals who perform work of greater responsibility have a higher cost opportunity of time than the unemployed. Working hours are also used to assess the trade-off between work, health investment and leisure and squared working hours are included to show possible non-linear effects. Furthermore, some binary variables indicate the area of residence; these covariates are included to control for any potential heterogeneity in CAM use and different lifestyle among geographical areas. A third group of variables controls for the health status of the respondents, in particular there are several binary variables that take the value one when chronic conditions, activity limitation and disability are reported, 0 otherwise. The perception of the psycho-physical status of the individuals is considered by introducing the indices of physical (Physical Component Score - PCS) and psychological (Mental Component Score - MCS) state. PCS and MCS are obtained from the SF-12 (Ware et al., 1996), a multipurpose survey, which studied eight different aspects of the health status: physical activity, role limitations due to physical health, emotional state, physical pain, perception state of general health, vitality, social activities and mental health. The summary of the scores allows constructing the two indices (PCS, MCS); in particular, increasing values of these indices indicate an improvement in the perceived health while, at very low levels of the indices - roughly under twenty points - health is considered poor. Finally, three binary variables are used to check whether the probability to use alternative medicines is influenced by the confidence in the general practitioner, in the hospital physicians and in other doctors and four binary regressors are introduced to evaluate if the use of CAM is affected by the trust in the Public Health System.

A detailed description of the variables is presented in the **Table 2.1**.

Table 2.1. Variable description and summary statistics.

Outcome variables	**Description**	Mean	S.D.[6]	No. of obs.
CAM	1= person used at least one CAM therapies in the past three years, 0 otherwise	.14	0.34	116024
Homeopathy	1= person used Homeopathy during the past year, 0 otherwise	.069	.254	116024
Manual Treatments	1= person used Manual Treatments during the past year, 0 otherwise	.067	.249	116024
Fit therapy	1= person used Fitotherapy in the past years, 0 otherwise	.037	.189	116024
Ago puncture	1= person used Agopuncture in the past year, 0 otherwise	.019	.138	116024
Controls				
Health behaviours				
Physical activity	1= moderate and vigorous physical activity, 0 otherwise	0.44	0.50	99342
Special diet	1 =person follows a special diet, 0 otherwise	.14	.35	116024
Non-smoker	1= person currently does not smoke, 0 otherwise	0.78	0.41	104342
Predisposing variables				
Sex	1 if female, 0 otherwise	.514	.499	116024
Age	Age of respondent	43.280	22.07	116024
Age2	Age at squared	2360.505	1976.374	116024
Illiterate	1 if no educational certificates, 0 otherwise	.054	.226	128040
Primary school	1 if primary school certificates, 0 otherwise	.209	.406	128040
Lower high school	1 if lower school certificate, 0 otherwise	.275	.447	128040
High School	1 if high school certificate, 0 otherwise	.254	.435	128040
University	1 if university certificate, 0 otherwise	.055	.229	128040
Postgraduate degree	1 if PhD certificate, 0 otherwise	.004	.066	128040
Marital status				
Single	1 if never married, 0 otherwise	.279	.449	128040
Married	1 if currently married, 0 otherwise	.457	.498	128040
Separated/divorced	1 if currently separated or divorced	.042	.199	128040
Widowed	1 if widowed, 0 otherwise	.221	.415	128040
Kids	1 if individual has children, 0 otherwise	0.712	.453	128040
Weight				
Under weight	1 if individual is under weight (BMI≤18.49), 0 otherwise	.025	.157	128040
Normal weight	1 if individual is normal weight (18.50≤BMI<25), 0 otherwise	.401	.490	128040

[6] Note: S.D. stands for standard deviation.

Outcome variables	**Description**	Mean	S.D.[6]	No. of obs.
Overweight	1 if individual is overweight (25≤BMI<30), 0 otherwise	.270	.444	128040
Obese	1 if individuals is obese (BMI≥30), 0 otherwise	.303	.459	128040
Control Weight	1 if person checks the weight daily or several times during the week, 0 otherwise	.189	.392	128040
Self-assessed family income				
Excellent	1 if person lives in a family with excellent economic resource, 0 otherwise	.033	.179	128040
Fair	1 if person lives in a family with fair economic resources, 0 otherwise	.595	.491	128040
Insufficient	1 if person lives in a family with insufficient economic resource, 0 otherwise	.238	.426	128040
Absolutely insufficient	1 if person lives in a family with absolutely insufficient economic resources, 0 otherwise	.133	.340	128040
Tenure status of the dwelling				
Rent	1 if person lives in a rented house, 0 otherwise	.152	.359	128040
Estate	1 if person lives in a house he/she owns, 0 otherwise	.688	.463	128040
Usufruct	1 person lives in a house with the right of usufruct, 0 otherwise	.015	.121	128040
Other	1 for person in other condition	.146	.353	128040
Villa	1 if person lives in a villa, 0 otherwise	.161	.367	113519
Socio-professional status[7] and working hours				
Unemployed	1= person non-working during last week, 0 otherwise	.545	.498	103066
Self-worker	1= person is self-employed, 0 otherwise	.240	.427	46997
Manager	1= person is a manager, 0 otherwise	.074	.262	46997
Skilled non-manual	1= person is a skilled non-manual worker, 0 otherwise	.314	.464	46997
Manual	1= person is a manual worker, 0 otherwise	.336	.472	46997
Other jobs	1=person for other jobs, 0 otherwise	.035	.185	46997
Working hours	number of hours effectively worked per week	39.795	11.958	49139
Working hours squared	squared number of working hours	1726.668	1050.776	49139
Area of residence				
Piemonte	1= person resides in Piemonte, 0 otherwise	.063	.244	128040
Valle Aosta	1= person resides in Val D'Aosta, 0 otherwise	.012	.110	128040

[7] Variables related to the sector of activity of the individuals are included in the estimates but the summary statistics are not shown.

Outcome variables	**Description**	Mean	S.D.[6]	No. of obs.
Lombardia	1=person resides in Lombardia, 0 otherwise	.094	.291	128040
Trentino Alto-Adige	1= person resides in Trentino, 0 otherwise	7.81e-06	.003	128040
Bolzano	1= person resides in Bolzano, 0 otherwise	.015	.122	128040
Trento	1= person resides in Trento, 0 otherwise	.014	.116	128040
Veneto	1=person resides in Veneto, 0 otherwise	.064	.246	128040
Friuli Venezia Giulia	1= person resides in Friuli Venezia Giulia, 0 otherwise	.290	.454	128040
Liguria	1= person resides in Liguria, 0 otherwise	.028	.167	128040
Emilia Romagna	1= person resides in Emilia Romagna, 0 otherwise	.060	.238	128040
Toscana	1=person resides in Toscana, 0 otherwise	.053	.223	128040
Umbria	1= person resides in Umbria, 0 otherwise	.021	.144	128040
Marche	1= person resides in Marche, 0 otherwise	.033	.179	128040
Lazio	1= person resides in Emilia Romagna, 0 otherwise	.050	.050	128040
Abruzzo	1=person resides in Abruzzo, 0 otherwise	.034	.180	128040
Molise	1= person resides in Molise, 0 otherwise	.015	.123	128040
Campania	1= person resides in Campania, 0 otherwise	.086	.281	128040
Puglia	1=person resides in Puglia, 0 otherwise	.070	.255	128040
Basilicata	1=person resides in Basilicata, 0 otherwise	.022	.146	128040
Calabria	1= person resides in Calabria, 0 otherwise	.042	.202	128040
Sicilia	1=person resides in Sicilia, 0 otherwise	.058	.234	128040
Sardegna	1=person resides in Sardegna, 0 otherwise	.042	.201	128040
Activity limitations and disability				
Limitations	1=person reports limitation from six months, 0 otherwise	.235	.424	128040
Accidents	1=person reports having had accidents in the last four weeks, 0 otherwise	.118	.323	128040
Use of rehabilitation services	1=person reports to use rehabilitations services in the last 3 months	.127	.333	128040
Blindness	1 = person is blind, 0 otherwise	.099	.299	128040
Deafness	1= person is deaf, 0 otherwise	.109	.312	128040
Motor disability	1=person suffers from motor disabilities, 0 otherwise	.119	.324	128040
Mental deficiency	1=person suffers from mental deficiency, 0 otherwise	.100	.300	128040
Mental illness	1=person suffers from mental illness, 0 otherwise	.006	.080	116024
Health and chronic conditions				

Outcome variables	**Description**	Mean	S.D.[6]	No. of obs.
Index of the physical state	Physical Component score - Health related quality of life instrument Short Form	50.343	9.353	104342
Index of mental state	Mental Component Score - Health related quality of life instrument Short Form	49.894	9.610	104342
Asthma	1= person suffers from asthma, 0 otherwise	.143	.350	128040
Allergies	1= person suffers from allergies, 0 otherwise	.198	.399	128040
Diabetes	1= person suffers from diabetes, 0 otherwise	.137	.343	128040
Emphysema	1=person suffers from emphysema, 0 otherwise	.137	.344	128040
Hypertension	1=person suffers from hypertension, 0 otherwise	.240	.427	128040
Heart attack	1=person has suffered from heart attack, 0 otherwise	.110	.313	128040
Other heart disease	1=person suffers from other heart disease	.130	.336	128040
Angina	1=person suffers from angina pectoris, 0 otherwise	.104	.305	128040
Stroke	1= person has suffered from stroke, 0 otherwise	.104	.305	128040
Osteoporosis	1=person suffers from osteoporosis, 0 otherwise	.144	.351	128040
Cancer	1= person suffers from cancer, 0 otherwise	.114	.318	128040
Migraine	1= person suffers from migraine, 0 otherwise	.189	.392	128040
Depression	1=person suffers from depression, 0 otherwise	.164	.370	128040
Endocrine disease	1= person suffers from endocrine disease, 0 otherwise	.136	.343	128040
Skin disease	1=person suffers from skin disease, 0 otherwise	.104	.305	128040
Other chronic diseases	1=person suffers from other chronic disease, 0 otherwise	.136	.343	128040
Confidence in the Health System				
Confidence in General Practitioner (G.P.)	1= person has confidence in the G.P., 0 otherwise	.499	.500	128040
Confidence in the hospital physician	1=person has confidence in hospital physicians, 0 otherwise	.099	.299	128040
Confidence in other physician	1=person has confidence in other physicians, 0 otherwise	.011	.107	128040
Opinion on the Public Health System in the last 12 months				
Public Health System is improving	1 if person reports that Public Health System is improving, 0 otherwise	.088	.284	128040
Public Health System is like before	1 if person reports that Public Health System is like before, 0 otherwise	.350	.477	128040
Public Health System is getting worse	1 if person reports that Public Health System is getting worse	.2203	.414	128040
No opinion	1 if person does not express an opinion, 0 otherwise	.115	.319	95319

2.4.4 Specification of the Probit model and empirical results

The relationship between CAM use and health behaviours is firstly analysed using a binary outcome model where the dependent variable, CAM use, is binary:

$$y_1 = \begin{cases} 1 \; with \; probability \; p \\ 0 \; with \; probability \; 1-p \end{cases}$$

It is expected that the probability to use CAM depends on several individual characteristics; in particular, a multivariate probit model is carried out and the conditional probability to use CAM is given by:

$p_i = \Pr[y_j = 1|x_j] = \varphi(B_1 + B_2 \, x_j)$,

where φ (.) is the cumulative distribution function for the standard normal.

The model for CAM use is specified as follow:

$$y^* = \alpha + \beta PA_i + \lambda SM_i + \delta SD_i + \zeta Z_i + \varepsilon_i, \; y = 1 \; [y^* > 0] \qquad (5)$$

where $y^*$is the latent variable that expresses the propensity to use CAM therapies: y^* is not observed but it is possible to observe y that ie equal to 1 (the individuals consume CAM) if $y^* > 0$, and 0 (individuals do not use CAM) otherwise. The variables PA_i, $SM_i$and SD_i indicate three healthy behaviours of the respondents: doing regular physical activity, non-smoking and following a healthy diet. As for the vector of control variables, Z_i, this includes several covariates already discussed in the previous paragraphs. Statistical analysis are carried out, also considering each alternative medicine included in the dataset (Manual treatments, Homeopathy, Herbal Medicines, Fitotherapy, Agopuncture) to assess whether the use of specific alternative therapies is associated with the adoption of healthy behaviours.

Furthermore, these estimates, while outlining possible associations between alternative cure and physical activity, smoking and diet, allow drawing up a general profile of the user of alternative medicine in Italy.

Statistical analysis are performed by using the STATA software, version 12.1. Five probit regressions are carried out to identify the factors associated with CAM, Manual Treatments, Herbal medicines, Fitotherapy and Agopuncture use during the past three years. The estimated marginal effects of the models are shown in **Table 2.2**.

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Table 2.2. Estimated marginal effects at the mean of the Probit model.

	CAM	Manual treatments	Homeopathy	Fitotherapy	Agopuncture
Independent variables					
Health behaviours					
Physical activity	.065*** (.004)	.040*** (.003)	.027*** (.002)	0.018*** (.002)	.003** (.001)
Special diet	.047*** (.006)	.017*** (.004)	.031*** (.003)	.020*** (.002)	.004** (.004)
Non-smoker	-.002 (.004)	-.004 (.003)	.004* (.003)	.002 (.002)	-.001 (.001)
Predisposing variables					
Sex	.057*** (.005)	.016*** (.003)	.043*** (.003)	.023*** (.002)	.007*** (.001)
Age	.011*** (.001)	.007*** (.001)	.006 *** (.001)	.003*** (.001)	.002*** (.000)
Age2	-.000*** (.000)	-.000*** (.000)	-.000*** (.000)	-.000*** (7.29e-06)	-.000*** (5.55e-06)
Illiterate	Reference group	Reference group	Reference group	Reference group	Reference group
Primary school	.026 (.019)	.0178 (.014)	.038** (.017)	.008 (.009)	.006 (.007)
Lower high school	.062 *** (.018)	.033*** (.013)	.067*** (.016)	.021** (.001)	.012* (.007)
High school	.088*** (.018)	.043*** (.013)	.078*** (.016)	.027*** (.009)	.018*** (.007)
University	.084*** (.019)	.037*** (.013)	.078*** (.016)	.033*** (.009)	.018*** (.007)
PhD	.057** (.027)	.020 (.019)	.056*** (.019)	.028** (.012)	.018** (.009)
Marital status					
Married	.021*** (.005)	.002 (.003)	.013*** (.003)	.002 (.002)	-.000 (.002)
Separated/Divorced	.029*** (.008)	.011** (.005)	.016*** (.005)	.008*** (.003)	.003 (.002)
Widowed	.012 (.016)	.002 (.011)	.010 (.010)	-.010 (.007)	.005 (.004)
Single	Reference group	Reference group	Reference group	Reference group	Reference group
Kids	-.023 *** (.004)	-.014*** (.003)	-.007*** (.003)	-.004** (.002)	-.004*** (.001)
Weight					
Under weight	.004 (.012)	-.012 (.009)	.011 (.007)	-.002 (.005)	-.005 (.004)
Normal weight	-.004	-.010**	.004	.002	-.000

	CAM	Manual treatments	Homeopathy	Fitotherapy	Agopuncture
	(.007)	(.005)	(.005)	(.003)	(.002)
Overweight	-.010 (.008)	-.010* (.005)	.000 (.005)	-.003 (.003)	.000 (.002)
Obese	Reference group	Reference group	Reference group	Reference group	Reference group
Weight Control	.023*** (.004)	.015*** (.003)	.009*** (.003)	.005*** (.002)	.000 (.001)
Self-assessed family income					
Excellent	.009 (.016)	.024** (.012)	.000 (.010)	-.013* (.007)	-.002 (.005)
Fair	.025** (.013)	.033 *** (.010)	.006 (.008)	-.004 (.005)	-.002 (.004)
Insufficient	.026** (.013)	.030** (.010)	.009 (.008)	.000 (.005)	.001 (.004)
Absolutely insufficient	Reference group	Reference group	Reference group	Reference group	Reference group
Tenure status of the dwelling					
Rent	-.001 (.008)	-.002 (.006)	.001 (.005)	-.008** (.004)	-.001 (.003)
Estate	.002 (.009)	-.002 (.006)	-.001 (.005)	-.008*** (.003)	.001 (.003)
Usufruct	.027 (.019)	.019 (.013)	.006 (.012)	-.019** (.009)	.010* (.006)
Other	Reference group	Reference group	Reference group	Reference group	Reference group
Villa	.012 ** (.005)	.004 (.003)	.004 (.003)	.004* (.002)	.004*** (.001)
Socio-professional status					
Unemployed	.001 (.008)	-.005 (.006)	.003 (.005)	.000 (.003)	.001 (.003)
Self-worker	.044*** (.012)	.018** (.008)	.022*** (.007)	.007*** (.005)	.006 (.004)
Manager	.025* (.014)	.011 (.009)	.023*** (.008)	.005* (.006)	.001 (.005)
Skilled non-manual	.021* (.012)	.007 (.008)	.014** (.007)	.004* (.005)	.001 (.004)
Manual	-.001 (.012)	-.005 (.008)	-.006 (.007)	.000 (.005)	.001 (.004)
Other jobs	Reference group	Reference group	Reference group	Reference group	Reference group
Sector of activity					
Agriculture, hunting, fishing	-.035*** (.010)	-.010 (.007)	-.042*** (.007)	-.009* (.005)	-.002 (.003)
Mining, energy	.011 (.020)	-.003 (.015)	.004 (.012)	.010 (.008)	-.003 (.008)

	CAM	Manual treatments	Homeopathy	Fitotherapy	Agopuncture
Industry and manufacturing activities	-.016** (.007)	-.003 (.005)	-.013*** (.004)	-.007** (.003)	-.001 (.002)
Construction	-.014 (.009)	-.007 (.006)	-.014** (.006)	-.006 (.004)	-.001 (.003)
Trade	-.008 (.007)	-.000 (.005)	-.011*** (.004)	-.005* (.003)	.001 (.002)
Hotels and restaurants	-.020* (.011)	.005 (.008)	-.022*** (.007)	-.009* (.005)	-.001 (.004)
Transport, storage and communications	-.028*** (.010)	-.007 (.007)	-.016** (.007)	-.003 (.005)	-.002 (.004)
Monetary and financial intermediation	-.000 (.013)	-.002 (.009)	.004 (.007)	-.010* (.006)	.001 (.004)
Real estate, renting, computer science, research and other professional or business activities	.004 (.010)	-.010 (.007)	.007 (.006)	-.005 (.004)	-.001 (.004)
Public administration and defence	-.008 (.009)	-.004 (.006)	-.007 (.005)	-.005 (.003)	.002 (.003)
Education	-.008 (.009)	-.005 (.006)	-.004 (.005)	-.003 (.004)	-.005 (.003)
Health and other social services	-.000 (.008)	-.000 (.006)	-.004 (.005)	.001 (.003)	.007*** (.003)
Others	Reference group	Reference group	Reference group	Reference group	Reference group
Working hours	-.000 (.000)	.000 (.000)	-.000 (.000)	-.003 (.000)	.000 (.000)
Working hours squared	.000 (6.24e-06)	1.25e-06 (4.36e-06)	2.73e-06 (4.03e-06)	2.73e-06 (2.86e-06)	-3.11e-06 (2.34e-06)
Area of residence					
Piemonte	-.035*** (.011)	-.028*** (.007)	-.005 (.007)	-.011** (.005)	-.002 (.004)
Valle Aosta	.010 (.016)	.002 (.011)	.014 (.009)	.006 (.006)	.016*** (.005)
Lombardia	-.045 *** (.010)	-.026*** (.007)	-.012* (.006)	-.014*** (.004)	-.001 (.004)
Trentino Alto-Adige	-	-	-	-	-
Bolzano	.032** (.014)	-.002 (.010)	.032*** (.008)	.019*** (.005)	.005 (.005)
Trento	-.012 (.015)	-.031*** (.011)	.011 (.009)	.011* (.006)	.004 (.005)
Veneto	-.003 (.011)	.000 (.007)	-.002 (.006)	.004 (.004)	-.001 (.004)
Friuli Venezia Giulia	.111*** (.013)	.066*** (.009)	.037*** (.008)	.017*** (.005)	.009** (.005)
Liguria	.019 (.014)	.004 (.010)	.009 (.008)	-.013** (.006)	.007 (.005)
Emilia Romagna	.059*** (.011)	.032*** (.008)	.018*** (.007)	-.000 (.005)	.013*** (.004)

	CAM	Manual treatments	Homeopathy	Fitotherapy	Agopuncture
Toscana	.055*** (.012)	.028 *** (.008)	.011 (.007)	.005 (.005)	.010** (.004)
Umbria	.027* (.015)	.027** (.011)	.005 (.009)	-.006 (.006)	.005 (.005)
Marche	.046 *** (.013)	.037*** (.010)	.005 (.008)	-.012** (.006)	.005 (.005)
Lazio	.005 (.012)	-.001 (.009)	-.004 (.007)	-.005 (.005)	.002 (.004)
Abruzzo	-.044 *** (.015)	-.010 (.011)	-.045*** (.010)	-.022*** (.0067)	.007 (.005)
Molise	-.082*** (.020)	-.030** (.014)	-.068*** (.015)	-.039*** (.010)	.004 (.006)
Campania	-.056 *** (.012)	-.028*** (.009)	-.035*** (.008)	-.026*** (.006)	.000 (.004)
Puglia	-.066*** (.013)	-.022** (.009)	-.050*** (.009)	-.034*** (.006)	-.005 (.00)
Basilicata	-.072*** (.019)	-.052*** (.015)	-.044*** (.012)	-.026*** (.009)	.002 (.006)
Calabria	-.082*** (.015)	-.032*** (.011)	-.062*** (.011)	-.038*** (.007)	-.003 (.005)
Sicilia	-.053*** (.013)	-.031*** (.010)	-.032*** (.008)	-.022*** (.006)	-.004 (.005)
Sardegna	Reference group	Reference group	Reference group	Reference group	Reference group
Activity limitations and disability					
Limitations	.030*** (.008)	.021 *** (.005)	.001 (.005)	.003 (.003)	.004* (.002)
Accidents	.023** (.011)	.016** (.007)	.013** (.006)	.007 (.004)	-.004 (.004)
Use of rehabilitation services	.145*** (.009)	.107*** (.006)	.028*** (.005)	.022*** (.003)	.014*** (.003)
Blindness	.007 (.046)	.002 (.031)	-.021 (.033)	.009 (.017)	.011 (.011)
Deafness	-.020 (.026)	-.007 (.017)	-.004 (.018)	-.001 (.011)	.004 (.007)
Motor disability	.027 (.017)	.026** (.011)	.002 (.011)	.005 (.007)	.006 (.005)
Mental deficiency	-.064 (.051)	-.102** (.046)	-.042 (.033)	.008 (.018)	-.001 (.015)
Mental illness	.028 (.076)	-.037 (.072)	.071 (.039)	.002 (.030)	.007 (.020)
Health and chronic conditions					
Index of the physical state	-.003*** (.000)	-.001*** (.000)	-.001*** (.000)	-.001*** (.000)	-.000*** (.000)
Index of mental state	-.001*** (.000)	-.000*** (.000)	-.001*** (.000)	-.000*** (.000)	-.000*** (.000)

	CAM	Manual treatments	Homeopathy	Fitotherapy	Agopuncture
Asthma	.005 (.009)	.009 (.006)	.001 (.005)	-.000 (.003)	.000 (.003)
Allergies	.053*** (.005)	.018*** (.004)	.031*** (.003)	.009*** (.002)	.004** (.002)
Diabetes	-.047*** (.015)	-.008 (.010)	-.033*** (.010)	-.012* (.006)	-.008 (.005)
Emphysema	-.016 (.013)	-.018** (.009)	-.004 (.008)	.010** (.005)	.003 (.004)
Hypertension	-.003 (.007)	-.004 (.005)	-.005 (.004)	.003 (.003)	-.000 (.002)
Heart attack	-.014 (.026)	-.002 (.017)	-.042** (.021)	-.024* (.013)	.003 (.007)
Other heart disease	.005 (.014)	.015 (.009)	-.008 (.009)	-.002 (.006)	.004 (.004)
Angina	-.094** (.037)	-.041 (.024)	-.057** (.027)	.000 (.013)	-.002 (.009)
Stroke	-.030 (.039)	-.032 (.026)	.006 (.022)	-.001 (.014)	-.009 (.012)
Osteoporosis	.001 (.015)	.010 (.010)	-.023** (.011)	-.006 (.006)	.002 (.004)
Cancer	-.033* (.018)	-.033*** (.013)	.001 (.010)	.001 (.006)	-.015** (.006)
Migraine	.045*** (.006)	.030*** (.004)	.014*** (.003)	.007*** (.002)	.008*** (.002)
Depression	.023*** (.008)	.011** (.005)	.017*** (.004)	.008*** (.003)	.002 (.002)
Endocrine disease	.006 (.009)	.001 (.006)	.006 (.005)	-.001 (.004)	.002 (.003)
Skin disease	.047 *** (.015)	.013 (.010)	.038*** (.008)	.017*** (.006)	.000 (.005)
Other chronic diseases	.047*** (.008)	.018*** (.005)	.019*** (.005)	.013*** (.003)	.008*** (.002)
Confidence in the Health System					
Confidence in G.P.	-.025*** (.004)	-.016*** (.003)	-.011*** (.002)	-.006*** (.002)	-.000 (.001)
Confidence in the hospital physician	-.020*** (.006)	-.014 *** (.004)	-.011*** (.003)	-.007*** (.002)	-.001 (.002)
Confidence in other physician	.047*** (.013)	.009*** (.009)	.027*** (.007)	.025*** (.004)	.008** (.004)
Opinion on the Public Health System in the last 12 months					
Public Health System is improving	-.001 (.008)	-.004 (.005)	.003 (.005)	-.006* (.003)	-.001 (.003)
Public Health System is like before	-.001 (.006)	-.006 (.004)	.002 (.004)	-.004 (.003)	-.002 (.002)
Public Health System is getting worse	.021*** (.006)	.007*** (.004)	.012*** (.004)	.000 (.003)	-.001 (.002)

	CAM	**Manual treatments**	**Homeopathy**	**Fitotherapy**	**Agopuncture**
No opinion	Reference group	Reference group	Reference group	Reference group	Reference group
N	34495	35327	35327	38817	38817
Adjusted R2	0.1398	0.1272	0.1536	0.1328	0.0734
Log-likelihood	-13515.627	-9403.5871	-8790.4726	-6552.221	-4011.5411
Wald Chi-square stat.	3692.12***	2431.95***	2606.52***	2006.23***	636.00***
AIC	27227.25	19003.17	17776.95	13310.44	8229.082
BIC	28055.21	19833.47	17776.95	14192.8	9111.443
Degree of freedom	98	98	98	102	103

Notes: SEs are displayed in parentheses. Significance levels: * $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.01$

The results of the Probit model outline that CAM use is more popular among physically active individuals: people who do regular physical activity are about 6% more likely use alternative cure compared to the sedentary. This positive and significant relationship is reported for each unconventional treatment. Similarly, the association between any CAM use and a healthy diet is also positive and significant: individuals who follow a diet low in salt and with less fat, etc. are about 5% more likely to choose alternative treatments.

Interestingly, the estimates show that individuals who regularly (every week) check their weight are more likely to use any CAM compared to people controlling their weight a few times a month or a few times a year.

The strong and positive relationships between CAM use and physical activity and healthy diet confirm what pointed out by the literature based on the relations between CAM and health behaviours. On the contrary, not significant is the relationship between any CAM use and non-smoking status: the only exception is the positive but weakly significant relationship between homeopathy and non-smokers.

Furthermore, in addition to discuss the association between CAM and lifestyle, a complete profile of the users of non-conventional medicine in Italy is outlined. Women are 6% more likely to use CAM than males. The level of education is a relevant predictor of the CAM use: people with a high education and a degree are about 9% more likely to choose alternative treatments compared to illiterate. In addition, positive and strongly significant is the relation between CAM use and professional jobs.

The association between CAM and age is not linear: the likelihood to use CAM increases for each additional age but, after a certain age threshold, the probability of using alternative therapies significantly reduces. Marital status and the presence of some children in the family also influence CAM use: the divorced are 3% (and the married 2%) more likely using CAM compared to the singles; individuals with some kids are 2% less likely to CAM use. Self-reported income status does not seem to affect significantly the use of unconventional cure. Area of residence of the respondents strongly influences the CAM use: those living in some regions of northern and central Italy, such as Bolzano, Friuli Venezia Giulia, Emilia Romagna, Toscana e Marche use significantly more CAM compared to the reference group (Sardegna). About health conditions, CAM users are more likely to report some limitations, motor disability and using rehabilitation services; diseases such as skin problems, allergies, migraines, and depression are some chronic conditions that significantly affect CAM use, while other severe problems, such as heart disease, stroke, cancer and endocrine disorders are not associated with alternative cure use. In addition, people who suffer from diabetes and angina-pectoris are around 5% and about 9% less likely to CAM use. Finally, the indices of physical and mental health affect significantly and negatively the use of CAM thus indicating that people, who report better perceived health, use less alternative therapies.

Interestingly, CAM use is significantly correlated to the trust that individuals have in the physicians: those who trust in G.P. and hospital physicians use significantly less alternative therapies, while those who have confidence in other physicians turn more to alternative treatments. Furthermore, a significant use of CAM is found among the respondents, who believe that the health system is getting worse.

To summarize, the estimates of the probit model outline that there is a strong association (at 1% significant level) between CAM use, an active lifestyle and a healthy diet. CAM use is more prevalent among females gender, separated/divorced, but also married people more than singles, individuals with a high level of education and with a professional job, living in some regions of North-East and Central Italy. About the health conditions, CAM use is common among individuals, who report some physical limitations and chronic diseases and that choose alternative therapies in order to satisfy a health need perhaps not adequately satisfied by traditional physicians.

2.4.5 Specification of the Recursive Probit model

An empirical analysis of the effect of healthy behaviours on CAM use could give rise to a problem of endogeneity and then, the estimates of the Probit model may be biased. In particular, physical activity, smoking status and following a special diet are potentially endogenous regressors in the CAM use equation, if unobserved characteristics of the individuals (such as risk aversion, differences in genetic endowment, time preference and any unknown social and physical factors) drive both CAM use and lifestyles. In addition, a problem of reverse causality may arise from the Probit estimates: it is no clear if CAM use is causally related to the habit under investigation in question or if there is only an association between CAM use and healthy behaviours. For this reason, a recursive probit model is applied and instrumental variables are used to increase the efficiency of the estimates.
Formally, a simultaneous equation model is applied to evaluate the relationship between any CAM use and health-related behaviours. The relationships between specific alternative therapies (agopuncture, fitotherapy, homeopathy and manual treatments) and healthy habits are not analysed by recursive probit models because the estimates of the probit models show a similar pattern between any CAM treatments and lifestyles and to prevent the estimates to be weak due to the shrinking of the number of observations.

The variables of the model are defined as follows:
Y_1 = Health behaviours (physical activity, special diet and no-cigarettes consumption)
Y_2 = Any CAM use in the past three years

The latent variables, that represent the propensity to use alternative therapies and to adopt healthy behaviours, are expressed as:

$$Y_1^* = \beta_1 X + Z_1 + \varepsilon_1 \quad (6)$$

$$Y_2^* = \alpha_1 Y_1 + \gamma_1 X + \varepsilon_2 \quad (7)$$

$Y_1 = 1$ if $Y_1^* > 0$,
0, otherwise
$Y_2 = 1$ if $Y_2^* > 0$,
0, otherwise

where Y_1^* and Y_2^* are latent variables for which only the dichotomous variables Y_1 and Y_2 can be observed, X is the set of covariates widely described in paragraph 2.4.2, $(\varepsilon_1 , \varepsilon_2)'$ is a vector of bivariate normally distributed disturbances with the usual restrictions, mean zero, $Var(\varepsilon_1) = Var(\varepsilon_2) = 1$ and Z is the exclusion restriction. The equations for health behaviours and CAM use are jointly estimated allowing a correlation, expressed by parameter "p", between the error terms ε_1 and ε_2. Thus, the model enables to estimate, in unbiased way, the effect of healthy behaviours on the probability of using CAM.

Equation (1) is referred to as the reduced form equation for the adoption of the three health behaviours, because exogenous covariates enter the equation. Equation (2) is referred to as the structural equation for CAM use because it contains, in addition to the exogenous covariates, the potentially endogenous lifestyle variables.

In particular, three separate regressions are performed to explore the impact of doing physical activity, no - smoking consumption and following special diet on alternative cure use. Furthermore, the three regression analysis are performed controlling for all the healthy habits; as already pointed out by the authors who discussed the relationship between medical services and health habits, the three lifestyles may be related each other. For example, "cigarette smokers may be less likely to exercise strenuously and more likely to be heavy drinkers" (Manning et al., 1991).

2.4.6 Identification problem and construction of instrumental variables

Maddala (1983) claims that the parameters of the second equation of the bivariate probit model are not identified and that an exclusion restriction on explanatory variables is necessary. Performing a bivariate probit model with an exclusion restriction means not including at least one variable in the structural equation and including the same variable in the reduced form equation. In fact, the identification problem in linear simultaneous equations arises, because a linear combination of equations contains exactly the same variables as an original equation. However, Wilde (2000) states that the classical identification problem does not exist and an exclusion restriction is not needed to identify the parameters in the simultaneous probit model because, even if X_{2i} contains the same

variables of X_{1i}, the second equation structurally differs by the term Y_{1i}. Even though no exclusion restriction is necessary for the identification of the CAM equation, to increase the efficiency of the estimation, instrumental variables that may be considered strong predictors of the three healthy behaviours are built and included only in the reduced form equations.

Regarding the strength of the exclusion restrictions (i.e., the instruments), two assumptions (Mclennan et al., 2003) are crucial to produce causal estimates of the relationship between CAM and lifestyles: the instrumental variables must be significant predictors of the adoption of healthy lifestyles and cannot have an independent effect on CAM use.

The instrumental variables are defined supposing that the adoption of individual behaviours is influenced by the role of "social norms". Social norms represent a "cultural phenomena that prescribe and proscribe behaviours in specific circumstances" (Hecher and Opp, 2001).

In particular, well-being literature[8] and other research communities have outlined that inter-personal comparison affects, significantly, the subjective assessment of happiness and health: people get utility by social comparison, in addition to the objective conditions (i.e., higher income). In this study, it is supposed that social comparison to people with similar characteristics and reporting healthy habits may influence the individual choice regarding the adoption of healthy lifestyles[9]. Thus, a proxy measure of social norms is calculated by averaging every health behaviour followed by people over all the observations within a reference group. To analyse the relationships between CAM and lifestyles, three separate estimates are carried out and three exclusion restrictions are necessary. Thus, three reference groups are built: they are made up of the individuals, who have the same sex and age, live in the same Italian region and that choose to adopt, respectively, an active lifestyle, non-smoking habit and following a special diet. In this way, the reference groups also controls for environmental conditions, such as the availability of green areas or gyms, influencing the lifestyles. Importantly, each group is composed of a number of persons not less than 10.

The strength of the above defined instruments is tested trough the First-Stage F Statistic; a

[8] At first, research on subjective well-being is focused on the investigation of the role of income on happiness; recently, well-being literature has reported that relative rather than absolute income influences happiness. In addition, other research communities, prevalently sociologists and epidemiologist, have pointed out that relative income contribute to the definition of health condition. These studies suggest that inter-personal comparison affects the subjective assessment of happiness and health (Carrieri, 2011).

[9] Similarly, Humphreys et al. (2014), who analyse the effect of active lifestyle on health status, use, as exclusion restriction in a bivariate probit model, a variable that describes an individual's self-reported "sense of belonging " to the local community to control the potential endogeneity of physical activity.

TSLS linear regression is performed as a test for weak instruments and the results are reported in the **Table 2.3.**

Table 2.3. Summary results for first-stage regressions.

Instruments for potential endogenous regressors	**Cragg-Donald Wald F-statistic**	**Kleibergen-Paap rk LM statistic**	**Kleibergen-Paap rk Wald statistic**
Instrument for physical activity			
Mean- physical activity	1078.40 ***	993.70***	1121.98***
Instrument for non-smokers			
Mean-non smokers	943.56 ***	883.24***	966.16***
Instrument for special diet			
Mean-special diet	739.73 ***	544.70***	599.63 ***

Notes: Significance levels: * $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.01$.

The F statistic exceeds the threshold for weak instruments according to Stock et al. (2002); in addition, the under identification test is carried out, considering both the hypothesis of homoskedasticity and heteroskedasticity (Kleibergen and Paap, 2006). The results globally confirm the power of the instrumental variables adopted and that each model is properly identified. However, another assumption has yet to be verified i.e. no correlation between the exclusion restrictions and CAM use. It is assumed that the instrumental variables should be unrelated to the choice to use alternative care after controlling for the three lifestyles and other observable characteristics. Recognizing that proving the validity of the exclusion restriction is difficult, a way to check that the instruments are not correlated to CAM use is to carry out three Probit estimations, where these variables are added as covariates to predict CAM use. **Table 2.4** reports the coefficients estimated between CAM use and the instruments for the healthy habits.

Table 2.4. Relations between CAM and exclusion restrictions (main covariates).

	Probit Model
Main variables	CAM
Instrument for physical activity	.015
	(.099)
Instrument for special diet	.130
	(.168)
Instrument for non- smoking	-.023
	(.114)

Notes: Robust SEs are displayed in parentheses. Significance levels: * $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.01$.

The statistical insignificance of the instruments for health behaviours in the CAM equations may suggest that the exclusion restrictions are reasonable and valid.

2.4.7 Empirical results of the Recursive Probit Model

To estimate the causal relationships between alternative therapies and physical activity, no-smoking and diet, three recursive probit model regressions are carried out. The estimated coefficients of the recursive models are fully presented in the Tables of Chapter 2. Is important noticing that the variables (age, sex, region) used to identify the reference group of individuals are included in the set of covariates; in this way, the coefficients of health behaviours are not contaminated by the variables chosen to identify the groups.

Table 2.5 and **Table 2.6** present the partial marginal effects of the three lifestyles on CAM use both for the probit model and bivariate probit model to highlight their differences.

Table 2.5. Estimated marginal effects of the Probit models (main covariates).

	Probit model - marginal effects		
Health behaviours	Physical activity	Special diet	No-smokers
CAM use	.065***	.047***	-.001
	(.004)	(.006)	(.004)

Notes: Robust SEs are displayed in parentheses. Significance levels: * $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.01$.

Table 2.6. Estimated marginal effects in the second equation of the recursive-probit models-(main covariates).

	Pr(cam=1,physically active=1)	Pr(cam=1,special diet=1)	Pr(cam=1,no- smoking=1
Health behaviours	Physical activity	Special diet	No-smokers
CAM use	.027*** (.008)	-.004 (.004)	-.003 (.018)
Estimated *p*	.018 (.058)	.190*** (.062)	.006 (.068)

Notes: Robust SEs are displayed in parentheses. Significance levels: * $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.10$.

The estimates of the marginal effects in the recursive probit model show that the individuals doing regular physical activity are about 3% more likely to use CAM than the sedentary ones. On the contrary, following a healthy diet and smoking habit does not affect, in a significant way, the CAM use.

As it regards to the sign of the relationship between CAM and physical activity, the probit model and recursive-probit model do not differ, even if the marginal effects shown by recursive probit model are much lower than the estimated effects reported by the probit model. About the significance level, a difference is reported for the relation between CAM and special diet: the estimates of the recursive probit model show that following a healthy diet does not significantly influence CAM use, while the probit model outlines a strong positive correlation between CAM and diet (at 1% level).

For the correlation coefficient between the two equations of the recursive models, the hypothesis of the absence of an endogeneity is not rejected (at 1% level) for physical activity as also shown in the Tables of Section 2.8. On the contrary, the relation between CAM and healthy diet is affected by unobservable variables correlated to both CAM and diet; the coefficient "*rho*" is highly significant. In this case, a simultaneous equations model is required to obtain unbiased results.

2.5 CAM USE AND HEALTH-RELATED BEHAVIOURS IN ENGLAND

2.5.1 CAM in England

The first data on the incidence of the use of alternative cure in England date back to a study conducted by Ernst and White (2000) who, based on a telephone survey of 1204 adults representative of U.K. population, outline that 20% of the respondents have used CAM during the past year. The authors also highlight that people use CAM therapies for its perceived effectiveness and its relaxing effects. Interesting information about CAM use in England are also shown by Thomas et al. (2001) who, based on random sample of 5010 adults, point out not only the high prevalence of CAM use during 1998 (28.3% of the English population had used CAM) but also estimate the annual out-of-pocket expenditure for the most established CAM therapies: £450 million. Thus, further research about cost-effectiveness of CAM treatments became relevant to promote easier access to alternative care via the NHS. In particular, Thomas et al. (2003) show that, despite the Government enquiry in 2001 to increase the coverage of CAM by NHS, the percentage of practices making NHS referrals for CAM therapies only increased by 24.6% to 26.8% and the full or partial payments by patients rose from 26 to 42% between 1995 and 2001. A recent study on CAM use among general population in England (Hunt et al., 2010) outlines the significant predictors of CAM: being women, with high education and in active employment, suffering from mental illness, consuming five or more portions of fruit and vegetable a day Importantly, as already above mentioned, the studies that analyse the influence of health behaviours on CAM use do not consider the problem of potential endogeneity caused by omitted variables and unobserved individual characteristics correlated with both behaviours and CAM. The main topic of the next paragraphs will deepen the analysis between CAM use and health behaviours in England starting from the empirical model already used for the Italian estimates. In fact, both Italian and English surveys contain data quite similar, collected in the same year (2005) and therefore the results will be comparable.

2.5.2 Empirical model and data description

The empirical model is similar to the model used to explain the use of CAM among the Italian population, in particular:

$$CAM_i = \alpha PA_i + \beta\ SM_i + \lambda\ FVC_i + \delta AC_i + \varphi\ Z_i + e_i \quad (8)$$

where PA_i indicates if individual is physically active, SM_i controls for the smoking status of the respondents, FVC_i captures the individual's choices regarding a healthy diet, in fact indicate the fruit and vegetables consumption per day, and AC_i refers to the alcohol habit. Z_i is a vector of other explanatory variables that will be described in detail.

The data to estimate the relationships between CAM and healthy habits among English population are derived from the Health Survey for England 2005 (HSE), a national household survey conducted every year, which includes questions on the health of people living in England, in addition to questions on CAM use and lifestyles. The data were collected between January and December 2005, using an interview with each eligible person in the household followed by a nurse visit.

An individual is considered a CAM user if he/she has used, during the past year before the interview, at least one of the following non-conventional therapies: acupuncture, homeopathy, chiropracter, herbal medicine, osteopathy, ayurvedic medicine, unani medicine, naturophaty, chinese medicine, nutritional therapies, aromatherapy, spiritual healing, massage therapy, reflexology, reiki, shiatsu, hypnotherapy, meditation, relaxation, crystal therapy, dowsing, iridology, kinesiology, MegaVit and other unconventional treatments. Four indicators of health habits are considered: active lifestyle, smoking habit, eating habits and alcohol consumption.

The variable that controls for the active lifestyle of the respondents is expressed by a binary indicator that takes the value one if the respondent is part of a sports club, gym and dance club, 0 otherwise. The consumption of five or more portion of fruit and vegetables every day[10] is considered an indicator of healthy eating habits; a binary variable that takes value

[10] The American Heart Association and other national agencies recommend a diet that includes ≥5 servings of fruit and vegetables daily. It is supposed that the combinations of fiber, micronutrients, antioxidant in these foods may reduce cardiovascular disease risk (CVD).

one if the respondent consumes at least five portions of fruit and vegetables is built. The variable non-smoker is a binary variable that takes values 1 if the respondent does not smoke, 0 if he/she currently smokes. Lastly, to analyse the effect of alcohol habits on CAM use, it is built a dummy variable that assumes value 1 if the respondents imbibe less than two drinks per day, 0 if they intakes two or more drinks per day. In fact, smoking and alcohol habits cannot be treated in a similar way: any smoking is considered harmful, while for drinking the results are ambiguous. In particular, some studies outline that light-moderate drinking may be harmful; others find that moderate alcohol consumption may have positive effects on health. Thus, as in Manning et al. (1991) that followed the practice of the National Center for Health Statistics, this study distinguishes between heavy drinkers and light drinkers/abstainers[11], considering the daily consumption of ethanol, a component of alcohol beverage that damages the body.

Regarding the other independent variables used in model (8), similarly to the estimates for Italy, a first group of covariates controls for gender, age, family status, weight. A second group of regressors controls for the social and economic conditions of the individuals: five dummies variables, indicating household income quintiles, capture the family income in the past twelve months. The level of education is expressed by seven binary variables that indicate if the individuals are illiterate, students have a primary, lower high school or high school certificate, not yet have a degree or have a complete degree. In addition, socio-economic status is also controlled by some variables that specify the type of individual's jobs: professional, managerial, skilled non manual, skilled manual, unskilled, students and other works. In addition, because labour time reduces the time for leisure, a binary variable indicates if the respondents work full or part-time. Dummies variables indicate the area of residence of the respondents and urban/rural indicator is added to consider any potential heterogeneity in CAM use and lifestyle among geographical areas. A third group of variables controls for the health status of the respondents; in particular, a binary variable assumes value 1 if the individuals report at least one of the following chronic conditions: diseases of the heart and circulation, angina pectoris, stroke, high blood pressure, blood disorders,

[11] Our definition of moderate drinkers is in line with what is stated by the Dietary Guidelines for Americans, 2010 that highlight "moderate drinking as no more than 1 drink per day for women and no more than 2 drinks per day for men" (U.S. Department of Agriculture and U.S. Department of Health and Human Services).

diabetes, diseases of the muscles, metabolic diseases, respiratory problems, skin diseases, digestive and urinary problems, eye problems, nervous system diseases and mental diseases. In addition, other binary variables control for bone fractures, mobility problems, moderate/acute pain, problems with usual activities, anxiety/depression status, longstanding illness and acute diseases (in the last two weeks).

A detailed description of the variables is presented in **Table 2.10.**

Table 2.7. Variable description and summary statistics.

Outcome variables	**Description**	No. of obs.	S.D.	Mean
CAM	1= person used at least one CAM therapies in the past years, 0 otherwise	13297	.358	.151
Independent variables				
Health behaviours				
Active lifestyle	1= person belongs to a sports club, gym or dance club	5315	.463	.312
Fruit and vegetable consumption	1 =person intakes at least five portions of fruit and vegetables every day, 0 otherwise	9840	.437	.257
Non-smoking	1= person currently does not smoke, 0 otherwise	6504	.664	.472
Non-heavy drinking	1= person currently imbibes less than two drinks per day, 0 otherwise	6604	.287	.452
Predisposing variables				
Sex	1 if female, 0 otherwise	13297	.539	.498
Age	Age of respondent	13297	44.359	26.375
Age2	Age at squared	13297	2663.352	2333.968
Illiterate	1 if no educational certificates, 0 otherwise	13297	.2643	.441
Primary school	1 if primary school certificates, 0 otherwise	13297	.036	.187
Lower high school	1 if lower school certificate, 0 otherwise	13297	.143	.350
High School	1 if high school certificate, 0 otherwise	13298	.068	.252
Below degree	1 if below degree certificate, 0 otherwise	13297	.078	.268
Degree or equivalent level	1 if degree/equivalent level, 0 otherwise	13297	.364	.481
Ethnicity				

Outcome variables	**Description**	No. of obs.	S.D.	Mean
White	1 if White, 0 otherwise	13297	.911	.284
Mixed	1 if Mixed, 0 otherwise	13297	.013	.114
Asian	1 if Asian or Asian British, 0 otherwise	13297	.046	.210
Black	1 if Black or Black British, 0 otherwise	13297	.018	.132
Other races	1 if Chinese or other ethnic group, 0 otherwise	13297	.011	.107
Marital status				
Single	1 if never married, 0 otherwise	13297	.164	.371
Married	1 if currently married, 0 otherwise	13297	.427	.495
Separated/divorced	1 if currently separated or divorced	13297	.078	.268
Widowed	1 if widowed, 0 otherwise	13297	.331	.470
Kids	1 if individual has some children, 0 otherwise	13297	.382	.486
Weight				
Under weight	1 if individual is under weight (BMI≤18.49), 0 otherwise	13297	.304	.460
Normal weight	1 if individual is normal weight (18.50≤BMI<25), 0 otherwise	13297	.281	.449
Overweight	1 if individual is overweight (25≤BMI<30), 0 otherwise	13297	.25	.436
Obese	1 if individuals is obese (BMI≥30), 0 otherwise	13297	.159	.366
Family income quintiles				
Bottom quintile	1 if household income is < £10,656, 0 otherwise	13297	.199	.399
2nd quintile	1 if household income is ≥ £10,656 but < £16,852, 0 otherwise	13297	.167	.373
3rd quintile	1 if household income is ≥ £16,852 but < £24,711, 0 otherwise	13297	.167	.373
4th quintile	1 if household income is,≥ £24,711 but < £39,436, 0 otherwise	13297	.675	.468
Top quintile	1 if household income is ≥£39,436, 0 otherwise	13297	.324	.468
Socio-professional status				
Employed	1= person is current employed, 0 otherwise	13297	.325	.468
Unemployed	1= person is unemployed, 0 otherwise	13297	.024	.155
Retired	1= person is retired, 0 otherwise	13297	.306	.461
Other	1= person is a skilled non-manual worker, 0 otherwise	13297	.344	.475
Professional	1 for professional job, 0 otherwise	13297	.044	.205
Managerial	1 for managerial job, 0 otherwise	13297	.126	.332
Skilled non-manual	1for skilled non manual job, 0 otherwise	13297	.139	.346
Semi-skilled manual	1 for semi-skilled manual job, 0 otherwise	13297	.169	.375
Skilled manual	1 for skilled manual job, 0 otherwise	13297	.213	.409
Other works	1 for other jobs, 0 otherwise	13297	.038	.191
Full time job	1= person works full time, 0 part-time	9745	.708	.454
Area of residence				
North East	1= person resides in the North East of England, 0 otherwise	13297	.061	.239

Outcome variables	**Description**	No. of obs.	S.D.	Mean
Nord West	1= person resides in North West, 0 otherwise	13297	.140	.347
Yorkshire & The Humber	1=person resides in Yorkshire, 0 otherwise	13297	.107	.309
East midlands	1= person resides in East midlands, 0 otherwise	13297	.092	.289
West midlands	1= person resides in West midlands, 0 otherwise	13297	.104	.305
East of England	1= person resides in East of England, 0 otherwise	13297	.111	.314
London	1=person resides in London, 0 otherwise	13297	.118	.322
South west/east	1= person resides in South West, 0 otherwise	13297	.267	.442
Urban rural indicator				
Urban	1 for urban area ≥10k, 0 for town or fringe, village, hamlet and isolated dwelling	13297	.786	.410
Activity limitations and disability				
Problems with usual activities	1=person reports some limitations or is unable to perform usual activities, 0 otherwise	9377	.193	.394
Fractures	1=person reports having had fractures in the last 12 months, 0 otherwise	13297	.035	.184
Pain or discomfort	1=person has moderate or extreme pain or discomfort, 0 otherwise	9419	.382	.486
Mobility problems	1=person suffers from motor disabilities, 0 otherwise	9425	.233	.423
Anxiety/depression	1=person suffers from anxiety/depression, 0 otherwise	9358	.179	.384
Health and chronic conditions				
Chronic conditions	1 if person report at least one of these chronic illness: diseases of the heart and circulation, angina, stroke, high blood pressure, blood disorders, diabetes, diseases of the muscles, metabolic diseases, respiratory problems, skin diseases, digestive and urinary problems, eye problems, nervous system diseases and mental diseases.	13227	.475	.499
Longstanding illness	1 if person reports to suffer from longstanding illness, 0 otherwise	13297	.448	.497
Acute sickness	1 if person have suffered from acute illness during the last four weeks	13293	.160	.366

Note: S.D. stands for standard deviation.

2.5.3 Probit model and empirical results

A complete profile of the users of any CAM therapies in U.K. emerges by the estimates of the

Probit model. In particular, differently from the estimates for the Italian data, the relationships between the use of each alternative treatment (included in the dataset) and lifestyles will not be assessed because of the small number of observations related to acupuncture, homeopathy, chiropracter, herbal medicine, osteopathy and the other therapies individually considered.

Table 2.8. Estimated marginal effects at the mean of the Probit model.

Independent variables	**CAM**	**SE**
Health behaviours		
Active lifestyle	.074 ***	(.022)
Fruit and vegetable consumption	.068***	(.022)
Non-smoking	.041 *	(.023)
Non-heavy drinking	-.006	(.027)
Predisposing variables		
Sex	.175***	(.024)
Age	.015**	(.007)
Age2	-.000**	(.000)
Illiterate	Reference group	-
Student	.217***	(.058)
Primary school	-.013	(.055)
Lower high school	.064*	(.036)
High School	.124***	(.040)
Below degree	.085**	(.042)
Degree or equivalent level	.106***	(.039)
Ethnicity		
White	-.182	(.122)
Mixed	-.114	(.156)
Asian	-.342*	(.178)
Black	-.203	(.159)
Chinese or other races	Reference group	-
Marital status		
Single	Reference group	-
Married	.098	(.032)
Separated/divorced	.159	(.039)
Widowed	.230	(.079)
Kids	-.022	(.026)
Weight		
Under weight	-.076**	(.040)
Normal weight	-.018	(.029)
Overweight	-.004	(.028)
Obese	Reference group	-
Family income quintiles		
Bottom quintile	.044	(.043)
2nd quintile	.020	(.033)
3rd quintile	.000	(.028)
4th quintile	-.031	
Top quintile	Reference group	-
Employment status		
Employed	0.050*	(.035)

Independent variables	**CAM**	**SE**
Unemployed	-.021	(.061)
Retired	-.072	(.057)
Other conditions	Reference group	-
Socio-professional status		
Professional	.112	(0.075)
Managerial	.174***	(.061)
Skilled non-manual	.122**	(.060)
Skilled manual	.073	(.061)
Semiskilled manual	.103*	(.061)
Other jobs	Reference group	Reference group
Full time job	-.0424913	(.026)
Area of residence		
North East	-.016	(.045)
Nord West	-.060*	(.035)
Yorkshire & The Humber	-.064*	(.036)
East midlands	.003	(.037)
West midlands	-.075**	(.038)
East of England	-.034	(.034)
London	.050	(.040)
South (West/East)	Reference group	-
Urban rural indicator		
Urban	-.037	(.025)
Rural	Reference group	-
Activity limitations and disability		
Problems with usual activities	.122***	(.045)
Fractures	-.101*	(.057)
Pain or discomfort	.073***	(.028)
Mobility problems	-.117***	(.046)
Anxiety/depression	.069***	(.026)
Health and chronic conditions		
Chronic conditions	-.0667	(.106)
Longstanding illness	.139	(.105)
Acute sickness	.047	(.031)
N	2304	
Adjusted R2	0.1065	
Wald test	281.61***	
Log-likelihood	-1306.5866	
Chi-square stat.	311.48 ***	
AIC	2721.173	
BIC	3031.263	
Degree of freedom	54	

Notes: Robust SEs are displayed in parentheses. Significance levels: * $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.01$.

About the associations between any CAM use and healthy habits, the estimates show that individuals physically active are about 8% more likely using alternative cure than the sedentary ones; people eating five portions or more of fruit and vegetables every day are 7% more likely to choose CAM than people consuming less than five portions per day. Positive and significantly at the 10% level is the relation between CAM and non-smoking habit, while there is not a significant effect of moderate-alcohol consumption on unconventional

treatments use.

As it regards the influence of other covariates on CAM use, females are 19% more likely to use CAM, people with high education level and students use significantly more CAM compared to the illiterate; marital status does not influence significantly the CAM use. About the age-effect, the relation is not linear: CAM use significantly increases with age, but the variable age squared is negative to indicate that, after a threshold age, the CAM use significantly reduces. Regarding ethnicity and area of residence, Asian people are less likely using CAM compared to Chinese and people of other races, and the individuals living in North West, Yorkshire and West Midlands are less likely to prefer CAM compared to people living in the South of England. Socio-professional status and household income do not seem to affect significantly the CAM use, but the employed people are significantly more likely to use CAM, at 10%level, than people in other work situations. Finally, people reporting some pains or discomfort are about 7% more likely use CAM; in addition, individuals declaring some problems with usual activities and suffering from anxiety/depression are significantly more likely using alternative cure. Finally, chronic conditions, longstanding diseases and acute illness are not significantly related to the CAM use.

To sum up, females with high education, employed, physically active, non-smoking and with healthy eating habits, reporting some pain/discomfort, anxiety/depression and problems with usual activity are significantly more likely to choose alternative therapies in U.K.

2.5.4 Recursive probit models and empirical results

To estimate the causal effect of an active lifestyle, healthy diet, non-smoking and non-heavy drinking on CAM use, four recursive probit models are carried out and consequently, four exclusion restrictions are introduced to better identify the equations for CAM.

The variables of the recursive probit model, fully described before (sect. 2.5.2), are defined as follows:

Y_1 = Health behaviours (active lifestyle, fruit and vegetable consumption, no-cigarettes consumption and non-heavy drinking)

Y_2 = Any CAM use in the past year

The latent variables underlying CAM use and heath behaviours are expressed as:

$Y_1^* = \beta_1 X + Z_1 + \varepsilon_1$ (9)

$Y_2^* = \alpha_1 Y_1 + \gamma_1 X + \varepsilon_2$ (10)

$Y_1 = 1$ if $Y_1^* > 0$,

0, otherwise

$Y_2 = 1$ if $Y_2^* > 0$,

0, otherwise

The instruments for the potential endogenous regressors - lifestyles - are built using the notion of social norm, as above argued. In particular, the reference group of individual *"i"* includes individuals reporting the same age or up to five years older, of the same sex, living in the same area of England. The groups are composed of 10 people, at least. To verify the power of the instruments for the potential endogenous regressors, the Wald-F statistics and the robust counterparts developed by Kleibergend and Paap (2006) are reported. Furthermore, to control for the non-correlation between CAM and the instruments, four probit models are carried out including the instruments (in addition to each lifestyle and the other variables) as covariates for the CAM equation. The main results are reported in the **Table 2.9** and **Table 2.10**.

Table 2.9. Summary results for first-stage regressions.

Instruments for potential endogenous regressors	**Cragg-Donald Wald F-statistic**	**Kleibergen-Paap rk LM statistic**	**Kleibergen-Paap rk Wald statistic**
Instrument for active lifestyle			
Mean- active lifestyle	56.14 ***	49.82***	53.71***
Instrument for non-smokers			
Mean-non smokers	73.14 ***	69.73***	77.16***
Instrument for fruit and vegetable consumption			
Mean-fruit and vegetable consumption	73.46 ***	68.46***	74.53***
Instrument for non-heavy drinking			
Mean no-heavy drinking	77.95***	66.82***	72.44***

Notes: Significance levels: * $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.01$.

Table 2.10. Relations between CAM and exclusion restrictions (main covariates).

	Probit Model
Main variables	CAM
Instrument for active lifestyle	.215
	(.357)
Instrument for fruit and vegetables consumption	-.388
	(.369)
Instrument for non- smoking	-.081
	(.292)
Instrument for non-heavy drinkers	.104
	(.360)

Notes: Significance levels: * $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.01$; Robust SEs are displayed in parentheses.

The tables show that the F-statistic exceeds the threshold for weak instruments (Stock et al., 2002) and that, there is not a significant correlation between CAM use and the instruments.

The main estimates of the marginal effects of the recursive probit model are reported in **Table 2.12** (the estimated coefficients of the CAM equations are reported in **Table 2.15** in the Tables of Chapter 2 and, to perform a comparison between probit and recursive probit models, the marginal effects of the healthy habits on CAM use, estimated by the probit model, are reported (**Table 2.11**).

Table 2.11. Estimated average marginal effects in the second equations of the recursive-probit models- (main covariates).

	Pr(cam=1,physically active=1)	Pr(cam=1,fruit and vegetable consumption=1)	Pr(cam=1,no-smoking=1	Pr(cam=1,no-heavy drinking=1
Health behaviours	Physical activity	Fruit and vegetable consumption	No-smokers	No-heavy drinking
CAM use	.014	-.030	.065	.014
	(.042)	(.032)	(.066)	(.017)
Estimated *p*	.051	.316	-.152	-.170
	(.258)	(.194)	(.227)	(.224)

Notes: Robust SEs are displayed in parentheses. Significance levels: * $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.10$.

Table 2.12. Estimated average marginal effects of the Probit models (main covariates).

	Probit model			
Health behaviours	Physical activity	Fruit and vegetable consumption	No-smokers	No-heavy drinkers
CAM use	.075 ***	.069***	.039*	-.006
	(.023)	(.023)	(.023)	(.028)

Notes: Robust SEs are displayed in parentheses. Significance levels: * $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.10$.

The estimates of the recursive probit model are highly different from those reported by the probit model: the effect of an active lifestyle and the fruit and vegetables consumption do not affect significantly CAM use. On the contrary, in the probit model, both the healthy lifestyles are significantly associated to CAM use at 1% level. Similarly, non-smoking habit, does not affect CAM use, while the probit model shows that non-smokers are about 4% more likely to use CAM (at 10% level).

To sum up, the adoption of healthy habits is not significantly related to CAM use among the English population. It is relevant outlining that the estimates of the probit model, not considering the potential endogeneity of lifestyle, are biased and thus, the simultaneous equations model is required.

2.6 COMPARISON BETWEEN ITALY AND ENGLAND

In this study the effect of healthy behaviours on CAM use is analysed using two different econometric methods and considering two different databases.

Firstly, the relations between CAM use and regular physical activity, following a healthy diet and non-smoking are investigated among the Italian population. Then, the relationships between physically active people, fruit and vegetables consumption, non-smoking status and non-heavy alcohol consumption and CAM are investigated on the English survey. Both the datasets include variables related to the use of CAM, socio-economic and demographic characteristics and health status of the respondents. Some CAM treatments are available through the NHS already at the time of the interview in England, while some alternative therapies were made available in some Italian regions mainly after the survey of 2005[12].

Probit models are carried out to delineate a general profile of CAM users in Italy and England without taking into account the potential endogeneity of lifestyles. The estimates show that active lifestyle and healthy eating habit are significantly associated to CAM use both in Italy and England: non-smoking habit is associated to CAM use only among English population (at 10% level). Other determinants of CAM use are similar enough: females with high education are more likely to use CAM than males and illiterates; the age-effect is not

[12] In Valle D'Aosta, homeopathy and acupuncture are covered by the Regional Health Service with a resolution of 3 December 2002 for the treatment of specific diseases and disorders.

linear both in England and Italy. These results suggest that CAM is more common among young and middle-aged people, while older people use significantly less CAM therapies. Surprisingly, the estimates show that the income is not a significant determinant of CAM use. However, managers and skilled non-manual are more likely to use CAM in England and self-employers are more likely to choose CAM in Italy. Marital status is significantly associated to CAM only in Italy. Regarding the health conditions, the pain, depression and some limitations in the usual activities influence positively and significantly CAM use in England and Italy.

Recursive probit models are performed to analyse the causal effect of every lifestyle in Italy and England and control for individual heterogeneity. The estimates based on the Italian sample outline a strong effect of physical activity on CAM use (at 1% level), while not significant is the effect of healthy diet on CAM.

Interestingly, all the healthy habits do not affect, in a significant way, CAM use in England; these results are completely different from those reported by the probit model.

The comparison between the estimates of the two econometrics methods allows pointing out the importance to take into account the presence of the omitted variables, potentially related to both CAM and lifestyles.

2.7 DISCUSSION

In this study, the effect of some healthy behaviours - active lifestyle, healthy eating habit, non-smoking, and non-heavy alcohol consumption - on CAM use is investigated among the Italian and English population. Grossman's model is referred: the individual combines market and non-market inputs to increase the stock of health, which depreciates over time. In particular, the individual is assumed to choose a healthy lifestyle, based on direct utility effects, subject to income and time constraints and, in this thesis, CAM use is explicitly included among market inputs.

The analysis of the relationships between medical and non-medical inputs in the health production function (Grossman, 1972 a, b) is relevant because the poor health habits are considered to be among the primary causes of illness and death; similarly to the health risk linked to unhealthy behaviours, there are important economic consequences of the increase in the medical costs. In fact, the relations between traditional healthcare utilization and lifestyles are investigated with different methods and in many Countries, as shown by the economics literature review. Importantly, this literature also outlines the extreme difficulty to establish a causal relationship between health behaviours and medical services because of the omitted variables (individual heterogeneity). About the main aspects of interests of this study compared to the previous literature, firstly, it investigates the effect of physically active behaviour, non-smoking and non-heavy drinking on CAM use taking into account the potential endogeneity issue. In fact, the empirical literature about the relations between CAM and healthy lifestyles is poor and of low quality. Secondly, the causal effect of healthy eating habits on the use of medical inputs among general population has never been analyzed by economics literature.

The presence of unobservable variables that may be correlated to both CAM and lifestyles is addressed performing a recursive probit model, given the binary nature of the variables of interest (adoption of healthy lifestyles and CAM use). Using this approach, it is also possible to give a causal interpretation of the relationships between CAM and lifestyles. Even if no exclusion restriction is required for the identification of CAM equation, instrumental variables for the potential endogenous regressors are built to increase the efficiency of the estimates. Starting from the literature on the influence of social norms on health and well-

being, this study points out that individual lifestyles are highly sensitive to the adoption of health behaviours among a reference group: the variables capturing the "social norm" effects are used as exclusion restrictions and included only in the equations for lifestyles.

Concerning the Italian population, the effect of regular physical activity on CAM use reported by recursive model is weaker, but still highly significant, than that reported by the probit model. Smoking habit does not affect the CAM use in both the econometrics analysis, while the relation between CAM and healthy diet is only significant in the probit model. This result highlights that the relation between CAM and healthy diet is influenced by an unobservable heterogeneity that affects the validity of the estimates carried out with the probit model.
About the English sample, the adoption of healthy habits is not significantly related to CAM use in the recursive probit specification; differently, the probit estimates report a strong and positive relation between healthy lifestyles and CAM. Only alcohol habits is not a significant predictor of CAM use both in the probit and recursive probit models.

Thus, the impact of lifestyles on CAM depends on the population under investigation.
The effect of lifestyle on CAM use is different from the effect of healthy habits on traditional care (analysed in the literature review): people use alternative treatments even if they are regularly engaged in physical activity. Thus, healthy habits reduce the traditional healthcare utilization and consequently the related costs but not CAM use. These results suggest that alternative treatments may be also considered as part of a healthy lifestyle that emphasizes preventive health care. In particular, following the definition of prevention by public health experts, CAM may be considered as belonging to the first category of prevention that "consists of actions, that reduce the occurrence or incidence of disease" such as health lifestyle decisions (Kenkel, 2000). On the other hand, CAM is also used by people suffering from some health chronic diseases such as migraine, allergies, skin problems, depression. Similarly, pain/discomfort, problems with usual activities and anxiety/depression affect significantly CAM use in England. Thus, CAM use also falls in the tertiary prevention, consisting of actions which reduce disability related to chronic conditions. Probably, people choose CAM treatments as an alternative or complement to other medical care practices

because of a lack of confidence in the G.P. and hospital physicians and in the National Health System in general, as shown by the estimates of this study. In addition, the non-linear relationship between CAM and age would be a further confirmation of the inclusion of CAM between the activities of prevention rather than curative; Grossman and Rand (1974), in an extension of Grossman's basic model, distinguish between prevention and curative care assuming that people with a low rate of depreciation - the youngest - , use preventive care, while those with a high rate of depreciation, mainly demand curative care. Furthermore, also the significant use of CAM by individuals with a high level of education is in line with empirical studies that emphasize a more consistent use of preventive medicine by people with more schooling (Rosenzweing and Schults, 1988; Kenkel, 1991a ,1991b, 1994; Leigh, 1990; Mullah, 1999). These studies suggest that schooling improve allocative efficiency of health production; however, many authors suggest that the estimated relations between schooling and preventive behaviours may be due to unobservable differences across individuals, first of all the individual rate of time preference. A future research could seek to analyze the relationship between CAM and schooling considering the problems of unobserved variables.

The determinants of CAM use shown by this study could better guide the work of CAM practitioners and policy makers. The former, should evaluate the effectiveness of alternative medicines, taking into account the different motivations that drive CAM use. The latter should consider that, the introduction of CAM therapies among the medical services covered by NHS, can be considered an important step in lowering the barriers to preventive care. Concerning the economic impact on health care costs, studies on the cost-effectiveness of prevention and cure outline the issue to reach a definitive conclusion, considering the strong difficulty to account for future medical costs. However, even if some studies highlight that in many cases, prevention activities will not be cheaper than cure (Russell, 1986; Tengs et al., 1995), public health professional are strong advocates of prevention. Finally, considering that "health economics research sheds more light on which policy tools may work to achieve the objective of more prevention and relative less light on whether encouraging more prevention is a reasonable policy goal" (Kenkel, 2000), this study suggests that the support of safe and effective CAM therapies may encourage more prevention and support a healthy lifestyle that promotes wellness.

2.8 TABLES OF CHAPTER 2

Table 2.13. Coefficients estimates of the second equation of the recursive-probit model - CAM and healthy behaviours in Italy.

Health behaviours	**Physical activity**	**Special diet**	**Non-smoking**
	0.270***	-0.113	-0.019
	(0.095)	(0.114)	(0.114)
Other health behaviours			
Physical activity	-	0.316***	0.299***
		(0.019)	(0.019)
Special diet	0.222***	-	0.221***
	(0.028)		(0.026)
Non-smoking	-0.007	-0.003	-
	(0.020)	(0.019)	
Predisposing variables			
Sex	0.262***	0.280***	0.266***
	(0.025)	(0.022)	(0.024)
Age	0.050***	0.049	0.049***
	(0.006)	(0.006)	(0.006)
Age2	-0.001***	-0.001	-0.001***
	(0.000)	(0.000)	(0.000)
Education			
Illiterate	-0.268**	-0.281**	-0.274**
	(0.120)	(0.119)	(0.119)
Primary school	-0.147	-0.146	-0.139
	(0.098)	(0.096)	(0.097)
Lower high school	0.017	0.012	0.017
	(0.091)	(0.089)	(0.090)
High school	0.141	0.138	0.137
	(0.089)	(0.088)	(0.088)
University	0.125	0.125	0.126
	(0.089)	(0.089)	(0.089)
PhD	Reference Group	Reference Group	Reference Group
Marital status			
Married	0.092***	0.093***	0.099**
	(0.026)	(0.024)	(0.025)
Separated/Divorced	0.134***	0.138***	0.143***
	(0.037)	(0.036)	(0.036)
Widowed	0.054	0.064	0.068
	(0.074)	(0.073)	(0.073)
Single	Reference Group	Reference Group	Reference Group
Kids	-0.106***	-0.106***	-0.105***
	(0.021)	(0.020)	(0.020)
Weight			
Under weight	0.023	0.010	0.034
	(0.058)	(0.057)	(0.057)
Normal weight	-0.015	-0.030	-0.015
	(0.036)	(0.034)	(0.034)
Overweight	-0.044	-0.051	-0.046
	(0.035)	(0.034)	(0.035)
Obese	Reference Group	Reference Group	Reference Group
Weight Control	0.112***	0.153***	0.108***

Health behaviours	**Physical activity**	**Special diet**	**Non-smoking**
	(0.023)	(0.025)	(0.020)
Self-assessed family income			
Excellent	0.041	0.051	0.037
	(0.076)	(0.076)	(0.076)
Fair	0.117*	0.122**	0.119**
	(0.060)	(0.060)	(0.060)
Insufficient	0.122**	0.128**	0.123**
	(0.062)	(0.061)	(0.061)
Absolutely insufficient	Reference Group	Reference Group	Reference Group
Tenure status of the dwelling			
Rent	0.006	0.006	0.008
	(0.037)	(0.037)	(0.037)
Estate	-0.009	-0.009	-0.008
	(0.042)	(0.041)	(0.042)
Usufruct	0.125	0.119	0.119
	(0.088)	(0.087)	(0.087)
Other	Reference Group	Reference Group	Reference Group
Villa	0.056***	0.051**	0.055**
	(0.022)	(0.022)	(0.022)
Socio-professional status			
Unemployed	0.005	0.002	0.000
	(0.039)	(0.038)	(0.038)
Self-worker	0.203***	0.190***	0.191***
	(0.055)	(0.054)	(0.054)
Manager/professional	0.118*	0.111*	0.110*
	(0.063)	(0.062)	(0.062)
Skilled non-manual	0.099*	0.088	0.092
	(0.055)	(0.054)	(0.054)
Manual	-0.007	-0.019	-0.012
	(0.054)	(0.053)	(0.054)
Other jobs	Reference Group	Reference Group	Reference Group
Sector of activity			
Agriculture, hunting, fishing	-0.164***	-0.160***	-0.158***
	(0.050)	(0.048)	(0.048)
Mining, energy	-0.008	0.016	0.019
	(0.096)	(0.093)	(0.094)
Industry and manufacturing activities	-0.077**	-0.081**	-0.078**
	(0.032)	(0.031)	(0.032)
Construction	-0.070*	-0.070*	-0.067
	(0.042)	(0.041)	(0.041)
Trade	-0.044	-0.041	-0.043
	(0.033)	(0.032)	(0.032)
Hotels and restaurants	-0.100*	-0.103**	-0.102**
	(0.053)	(0.052)	(0.052)
Transport, storage and communications	-0.139***	-0.128***	-0.129***
	(0.049)	(0.049)	(0.049)
Monetary and financial intermediation	0.002	-0.004	0.002
	(0.060)	(0.059)	(0.059)
Real estate, renting, computer science, research and other professional or business activities	0.028	0.018	0.017
	(0.048)	(0.048)	(0.048)
Public administration and defence	-0.040	-0.044	-0.043
	(0.039)	(0.039)	(0.039)
Education	-0.041	-0.038	-0.041
	(0.043)	(0.042)	(0.042)

Health behaviours	**Physical activity**	**Special diet**	**Non-smoking**
Health and other social services	0.002	-0.007	-0.003
	(0.039)	(0.039)	(0.039)
Others	Reference Group	Reference Group	Reference Group
Working hours	-0.003	-0.003	-0.003
	(0.003)	(0.003)	(0.003)
Working hours squared	0.000	0.000*	0.000
	(0.000)	(0.000)	(0.000)
Area of residence			
Piemonte	-0.165***	-0.154***	-0.163***
	(0.051)	(0.051)	(0.051)
Valle Aosta	0.059	0.097	0.083
	(0.090)	(0.078)	(0.078)
Lombardia	-0.211***	-0.199***	-0.208***
	(0.048)	(0.048)	(0.048)
Trentino Alto-Adige	Reference Group	Reference Group	Reference Group
Bolzano	0.183**	0.154**	0.158**
	(0.076)	(0.068)	(0.068)
Trento	-0.007	-0.040	-0.049
	(0.083)	(0.073)	(0.073)
Veneto	-0.015	-0.002	-0.014
	(0.050)	(0.050)	(0.050)
Friuli Venezia Giulia	0.511***	0.494***	0.509***
	(0.060)	(0.060)	(0.060)
Liguria	0.087	0.088	0.086
	(0.063)	(0.063)	(0.063)
Emilia Romagna	0.274***	0.276***	0.273***
	(0.051)	(0.051)	(0.052)
Toscana	0.254***	0.256***	0.253***
	(0.053)	(0.053)	(0.053)
Umbria	0.126*	0.109	0.113
	(0.071)	(0.070)	(0.070)
Marche	0.210	0.208***	0.210***
	(0.059)	(0.058)	(0.059)
Lazio	0.022	0.040	0.024***
	(0.056)	(0.056)	(0.057)
Abruzzo	-0.210***	-0.208***	-0.203***
	(0.070)	(0.069)	(0.070)
Molise	-0.364***	-0.350***	-0.352***
	(0.095)	(0.092)	(0.092)
Campania	-0.263***	-0.249***	-0.258***
	(0.059)	(0.058)	(0.058)
Puglia	-0.304***	-0.296***	-0.302***
	(0.060)	(0.060)	(0.060)
Basilicata	-0.342***	-0.347***	-0.347***
	(0.087)	(0.086)	(0.086)
Calabria	-0.378***	-0.364***	-0.376***
	(0.070)	(0.070)	(0.070)
Sicilia	-0.249***	-0.235***	-0.244***
	(0.063)	(0.062)	(0.062)
Sardegna	Reference Group	Reference Group	Reference Group
Activity limitations and disability			
Limitations	0.138***	0.157***	0.134***
	(0.035)	(0.035)	(0.035)
Accidents	0.110**	0.103**	0.100**

Health behaviours	**Physical activity**	**Special diet**	**Non-smoking**
	(0.049)	(0.048)	(0.049)
Use of rehabilitation services	0.672***	0.657***	0.660***
	(0.042)	(0.041)	(0.041)
Blindness	-0.009	-0.040	-0.023
	(0.205)	(0.201)	(0.202)
Deafness	-0.082	-0.074	-0.086
	(0.121)	(0.120)	(0.120)
Motor disability	0.133*	0.115	0.123
	(0.077)	(0.077)	(0.077)
Mental deficiency	-0.283	-0.253	-0.299
	(0.237)	(0.234)	(0.235)
Mental illness	0.115	0.118	0.126
	(0.305)	(0.303)	(0.305)
Health and chronic conditions			
Index of the physical state	-0.012***	-0.013***	-0.012***
	(0.002)	(0.001)	(0.001)
Index of mental state	-0.006***	-0.007***	-0.006***
	(0.001)	(0.001)	(0.001)
Asthma	0.013	0.017	0.017
	(0.040)	(0.039)	(0.039)
Allergies	0.244***	0.249***	0.244***
	(0.024)	(0.024)	(0.024)
Diabetes	-0.217***	-0.087	-0.217***
	(0.068)	(0.080)	(0.067)
Emphysema	-0.072	-0.058	-0.063
	(0.061)	(0.059)	(0.061)
Hypertension	-0.015	0.018	-0.017
	(0.032)	(0.034)	(0.032)
Heart attack	-0.028	-0.018	-0.063
	(0.117)	(0.117)	(0.117)
Other heart disease	0.033	0.033	0.024
	(0.067)	(0.066)	(0.066)
Angina	-0.432***	-0.392***	-0.386**
	(0.160)	(0.154)	(0.155)
Stroke	-0.141	-0.070	-0.115
	(0.171)	(0.169)	(0.169)
Osteoporosis	0.004	0.009	0.011
	(0.071)	(0.070)	(0.071)
Cancer	-0.153*	-0.148*	-0.141*
	(0.079)	(0.077)	(0.078)
Migraine	0.203***	0.200***	0.202***
	(0.026)	(0.025)	(0.026)
Depression	0.108***	0.116***	0.105***
	(0.036)	(0.036)	(0.036)
Endocrine disease	0.027	0.027	0.020
	(0.043)	(0.042)	(0.042)
Skin disease	0.218***	0.235***	0.228***
	(0.070)	(0.069)	(0.069)
Other chronic diseases	0.216***	0.232***	0.218***
	(0.037)	(0.037)	(0.036)
Confidence in the Health System			
Confidence in G.P.	-0.117***	-0.120***	-0.117***
	(0.018)	(0.018)	(0.018)
Confidence in the hospital physician	-0.090***	-0.078***	-0.081***
	(0.026)	(0.026)	(0.026)

Health behaviours	**Physical activity**	**Special diet**	**Non-smoking**
Confidence in other physician	0.218***	0.209***	0.215***
	(0.059)	(0.058)	(0.058)
Opinion on the Public Health System in the last 12 months			
Public Health System is improving	-0.003	0.008	-0.003
	(0.037)	(0.036)	(0.036)
Public Health System is like before	-0.004	0.001	-0.002
	(0.029)	(0.028)	(0.028)
Public Health System is getting worse	0.097***	0.100***	0.095***
	(0.030)	(0.030)	(0.030)
No opinion	Reference Group	Reference Group	Reference Group
Cons	-1.705**	-1.628***	-1.683***
	(0.217)	(0.216)	(0.228)
N	34495	34992	34992
Log-likelihood	-33381.09	-24147.12	-33696.08
Wald stat.	8992.34***	7205.24***	6585.22***
AIC	67156.17	48688.24	67786.16
BIC	68820.54	50355.43	69453.35
Degree of freedom	197	197	197

Notes: Robust SEs are displayed in parentheses. Significance levels: *p≤0.10, **p≤0.05, ***p≤0.01.

Table 2.14. Exogeneity test - H_0: $\rho = 0$, recursive probit models (Italian survey).

Healthy behaviours	Regular physical activity			Special diet			No-smoking		
	$\hat{\rho}$	Z-test	Wald test of $\hat{\rho}$	$\hat{\rho}$	Z-test	Wald test of $\hat{\rho}$	$\hat{\rho}$	Z-test	Wald test of $\hat{\rho}$
CAM use	.018	0.32	.103	.190	3.07	9.41***	.006	0.09	.008

Notes: significance levels: * p≤0.10, ** p≤0.05, *** p≤0.01.

Table 2.15. Coefficients estimates of the second equations of the recursive-probit model - CAM and healthy behaviours in England.

Endogenous regressors	**Active lifestyle**	**Fruit and vegetable consumption**	**Non-smoking**	**Non-heavy drinking**
	.173	-.329	.383	.283
	(.427)	(.319)	(.371)	(.397)
Predisposing variables				
Sex	.481***	.507***	.503***	.472***
	(.068)	(.067)	(.070)	(.077)
Age	.039**	.047**	.048**	.041**
	(.019)	(.018)	(.020)	(.019)
Age2	-.000**	-.000**	-.000**	-.000**
	(.000)	(.000)	(.000)	(.000)
Other health behaviours				
Active lifestyle	-	.253***	.191***	.218***
		(.068)	(.073)	(.064)

Endogenous regressors	Active lifestyle	Fruit and vegetable consumption	Non-smoking	Non-heavy drinking
Fruit and vegetable consumption	.194**	-	.165**	.198***
	(.077)		(.079)	(.065)
Non-smoking	.107	.162**	-	.081
	(.074)	(.069)		(.068)
Non-heavy drinking	-.030	-.036	-.050	-
	(.080)	(.0778)	(.084)	
Education				
Illiterate	Reference Group	Reference Group	Reference Group	Reference Group
Student	.586***	.625***	.541***	.626***
	(.178)	(.163)	(.178)	(.168)
Primary school	-.054	-.024	-.077	-.073
	(.155)	(.154)	(.159)	(.157)
Lower high school	.171*	.192*	.165	.180*
	(.103)	(.099)	(.106)	(.101)
High School	.341***	.382***	.312**	.337***
	(.120)	(.113)	(.126)	(.116)
Below degree	.238*	.303**	.200	.225*
	(.125)	(.122)	(.130)	(.121)
Degree or equivalent level	.290**	.368***	.240*	.301***
	(.121)	(.115)	(.139)	(.113)
Ethnicity				
White	-.507	-.405	-.536	-.474
	(.347)	(.351)	(.346)	(.351)
Mixed	-.325	-.215	-.309	-.280
	(.444)	(.442)	(.442)	(.445)
Asian	-.941*	-.914*	-.955*	-.938*
	(.504)	(.500)	(.503)	(.502)
Black	-.553	-.416	-.592	-.610
	(.459)	(.460)	(.451)	(.450)
Chinese or other races	Reference Group	Reference Group	Reference Group	Reference Group
Marital status				
Single	Reference Group	Reference Group	Reference Group	Reference Group
Married	.095	.046	.047	.092
	(.091)	(.095)	(.112)	(.092)
Separated/divorced	.176	.123	.167	.186*
	(.113)	(.115)	(.113)	(.113)
Widowed	.300	.281	.264	.275
	(.225)	(.222)	(.231)	(.230)
Kids	-.059	-.052	-.048	-.051
	(.074)	(.074)	(.076)	(.075)
Weight				
Under weight	-.239**	-.254**	-.236*	-.253**
	(.114)	(.112)	(.117)	(.114)
Normal weight	-.058	-.067	-.037	-.062
	(.083)	(.082)	(.091)	(.083)
Overweight	-.015	-.016	-.015	-.028
	(.080)	(.079)	(.081)	(.079)
Obese	Reference Group	Reference Group	Reference Group	Reference Group
Family income quintiles				
Bottom quintile	.120	.105	.156	.121

Endogenous regressors	Active lifestyle	Fruit and vegetable consumption	Non-smoking	Non-heavy drinking
	(.126)	(.121)	(.125)	(.122)
2nd quintile	.047	.051	.073	.023
	(.107)	(.105)	(.108)	(.108)
3rd quintile	.003	.010	.039	-.025
	(.093)	(.092)	(.097)	(.097)
4th quintile	-.105	-.119	-.107	-.100
	(.083)	(.078)	(.081)	(.078)
Top quintile	Reference Group	Reference Group	Reference Group	Reference Group
Employment status				
Employed	.141	.172*	.188*	.197**
	(.099)	(.099)	(.100)	(.100)
Unemployed	-.096	-.036	-.021	-.076
	(.172)	(.170)	(.177)	(.173)
Retired	-.199	-.146	-.149	-.173
	(.162)	(.160)	(0.162)	(.163)
Other conditions	Reference Group	Reference Group	Reference Group	Reference Group
Socio-professional status				
Professional	.351	-.254	-.183	-.204
	(.215)	(.212)	(.219)	(.214)
Managerial	.515***	.029	.029	.003
	(.172)	(.154)	(.158)	(.156)
Skilled non-manual	.364**	-.077	-.040	-.054
	(.172)	(.151)	(.159)	(.153)
Skilled manual	.235	.082	.096	.043
	(.173)	(.144)	(.148)	(.147)
Semi-skilled manual	.305*	.236*	.240*	.20
	(.174)	(.132)	(.137)	(.133)
Unskilled	Reference Group	Reference Group	Reference Group	Reference Group
Full-time job	-.121	-.110	-.096	-.095
	(.074)	(.073)	(.076)	(.075)
Area of residence				
North East	-.056	-.061	.024	-.054
	(.129)	(.127)	(.139)	(.136)
Nord West	-.167*	-.172*	-.142	-.152
	(.099)	(.097)	(.099)	(0.100)
Yorkshire & The Humber	-.182*	-.189*	-.174*	-.162
	(.102)	(.099)	(.102)	(.105)
East midlands	.006	.010	.020	.020
	(.109)	(.104)	(.106)	(.108)
West midlands	-.224**	-.190*	-.194*	-.192*
	(.111)	(.106)	(.107)	(.108)
East of England	-.099	-.112	-.080	-.090
	(.097)	(.097)	(.097)	(.097)
London	.150	.176	.185	.151
	(.114)	(.113)	(.117)	(.114)
South (West/East)	Reference group	Reference group	Reference group	Reference group
Urban rural indicator				
Urban	-.106	-.124*	-.101	-.081
	(.074)	(.071)	(.072)	(.074)
Activity limitations and				

Endogenous regressors	Active lifestyle	Fruit and vegetable consumption	Non-smoking	Non-heavy drinking
disability				
Problems with usual activities	.338***	.333***	.336***	.356***
	(.130)	(.129)	(.131)	(.130)
Fractures	-.285*	-.298*	-.239	-.274*
	(.163)	(.161)	(.168)	(.162)
Pain or discomfort	.205***	.186**	.170**	.202***
	(.079)	(.079)	(.084)	(.079)
Mobility problems	-.328**	-.323**	-.292**	-.325**
	(.135)	(.129)	(.134)	(.130)
Anxiety/depression	.197***	.179**	.210***	.192***
	(.075)	(.075)	(.081)	(.075)
Health and chronic conditions				
Chronic conditions	-.208	-.157	-.196	-.214
	(.304)	(.297)	(.299)	(.299)
Longstanding illness	.397	.335	.382	.414
	(.302)	(.297)	(.298)	(.298)
Acute sickness	.135	.135	.142	.113
	(.087)	(.086)	(.089)	(.087)
N	2319	2324	2288	2304
Log-likelihood	-2578.314	-2518.7855	-2577.1444	-2222.909
Wald chi2 (102)	553.76***	516.79***	739.98***	
AIC	5370.628	5251.571	5368.289	4659.818
BIC	5985.759	5866.933	5981.98	5274.255
dg	107	107	107	107

Notes: Robust SEs are displayed in parentheses. Significance levels: *p≤0.05, **p≤0.01, ***p≤0.001.

Table 2.16. Exogeneity test - H_0: $\rho = 0$, recursive probit models (English survey).

Healthy behaviors	Active lifestye			Fruit and vegetable consumption			No-smoking			No-heavy drinking		
CAM use	$\hat{\rho}$	Z-test	Test LR	$\hat{\rho}$	Z-test	Test LR	$\hat{\rho}$	Z-test	Test LR	ρ	Z-test	Test LR
	.015	0.06	.003	.317	1.53	2.48	-.144	-.63	.405	-.18	-0.78	.624

Notes: significance levels: * p≤0.10, ** p≤0.05, *** p≤0.01.

3 THE EFFECT OF REGULAR PHYSICAL ACTIVITY ON OTHER HEALTH-RELATED BEHAVIOURS IN ITALY

3.1 INTRODUCTION

Monitoring of the health and lifestyles of the Italian population has assumed considerable importance in recent years. In particular, in 2006 the Italian Ministry of Health funded the National Health Institute (ISS,) whose purpose is "to develop ongoing surveillance in adults of major behavioural risk factors and of preventive measures included in the National Prevention Plan"(http://www.epicentro.iss.it/passi/en/english.asp). The specific project is named "PASSI" (Progressi delle Aziende Sanitarie per la Salute in Italia - Progress by local health units towards a healthier Italy), and one of its main activities is to collect data on physical activity, diet, smoking, consumption of alcohol, physical-psychological state. In particular, from the data 2010-2013 it emerges that" only 33% of the respondents 18-69 years aged can be classified as active (performs an heavy work or 30 minutes of moderate activity for at least 5 days a week or vigorous activity for more 20 minutes to 3 days), 36% as partially active (without an heavy work but doing some physical activity during leisure time, below the recommended levels), and as much as 31% can be classified as sedentary (neither heavy work nor practice physical activity in leisure time)".

Similarly, the survey "Aspects of daily life, Year 2009" conducted by ISTAT, outlines that "about 18 million people over the age of 3 years (31% of the population) do sports: 21.5% continuously and 9.6% occasionally. The 28% of the population (approximately 16 million people) performs physical activity without playing a sport and more than 23 million people (40.6% of the population) are sedentary". In addition, the level of physical activity is significantly different among the Italian regions: the autonomous provinces of Bolzano (55.1%) and Trento (41.5%) report higher and continuous levels of physical activity, while lower levels are shown in Campania (21.2%), Molise (22.1%), Sicily (22.5%) and Calabria (23.8%).

The data are troubling because moving regularly produces positive effects on physical and mental health of the person. In fact, the effect of physical activity on the incidence of obesity and preventable chronic disease is well known (US Department of Health and Human Services, 1996; Kesaniemi et al., 2001; Craig et al., 2005; Chen and Mao, 2006; Warburton et al., 2006). However, the full impact of physical activity on health can be assessed only if, beside to the direct effects, even indirect ones are considered. In particular, the physical exercise could indirectly influence the health status by acting through other healthy behaviours, such as smoking and diet. Even though there is a widespread perception that those who are physically active tend to adopt more healthy lifestyles, in practice, establishing a causal relationship is quite difficult because of many reasons. Firstly, decisions concerning the adoption of healthy lifestyles can be presumably affected by some unobserved variables, such as time preferences, opportunity costs and risk aversion. Secondly, even controlled experiments have some limitations, both in terms of practical feasibility due to high operating costs, and because they often focus on individuals with particular characteristics and it is not possible to generalize the results. Furthermore, although the general population surveys include questions on lifestyles, it is possible that individuals over-report physical activity and under-report engagement in negative health behaviours.

In the literature the influence of physical activity on smoking habit is mainly dealt with controlled trials based on smokers or adolescents; on the other hand, the effect of exercise on the diet is investigated by some studies that merely report a positive association between physical activity and healthy diet.

In this chapter, the effect of physical activity on both the adoption of healthy diet and smoking habit is investigated for a representative sample of the general Italian population. Assessing the impact of physical activity on other lifestyles could have significant implications, not only for the medical research but also to implement and support health education and health promotion programs (Blair et al., 1985). In particular, if those who exercise regularly are less likely to smoke, then incentives and subsidies for sports could have the indirect effect of reducing the health care costs associated with smoking. In a similar way, programs aimed to encourage a regular physical activity could have effect also on the reduction of medical costs related to negative eating habits: physically active people, although could have higher caloric intakes than inactive individuals (Short et al., 1983), may

adopt a healthier diet composition compared to the sedentary people: eating healthier can help to improve their performance during the exercises.

This chapter is organized as follows: the first section analyzes the literature about the relationships between physical activity, smoking and diet. Then, an attempt to estimate the causal effect of physical activity on smoking and healthy diet is carried out controlling for the potential endogeneity of physical activity by the introduction of some instrumental variables. Particular attention will be devoted to the econometric model, including the identification problems, and the strengths and weaknesses of the analysis will be discussed.

3.2 THE EFFECT OF PHYSICAL ACTIVITY ON SMOKING AND DIET

3.2.1 Physical activity and smoking

In recent years, there has been a growing interest for the effects of physical activity on smoking behaviour. In particular, this topic has been analysed both through cross-sectional surveys and experimental designs.

Boutelle et al. (2000) analyse the associations between leisure-time exercise and some health behaviours in 24 worksites in the Minneapolis-St. Paul metropolitan area (USA). The study suggests that high levels of leisure time exercise are inversely related to smoking habit.

Similarly, a strong and negative association between physical activity and smoking is outlined (Hu et al., 2002) by a logistic regression analysis on a cross-sectional population survey carried out in urban areas of Tianjin (China).

A cross-section survey (n= 11.631) is also used to study the association between physical activity behaviour and other health lifestyles among a representative sample of high school students from all the 50 states of US and District of Columbia (Pate et al., 1996). In this study, the students who met both the Healthy People 2000 physical activity objectives and other physical activity guidelines for adolescents (Sallis et al., 1994) during the past 14 days are considered to be highly active (in particular, 2652 individuals reported 6 or more days of hard exercise and 6 or more days of light exercise). On the contrary, the control group includes the adolescents (n=1641) doing fewer than 2 days of light exercise and no days of hard exercise. The logistic regression analysis points out that the adolescents in the control group are more likely to consume cigarettes, in addition to marijuana use.

Ussher et al. (2001) investigate the effect of moderate aerobic exercise on the smoking desire and withdrawal symptoms in the abstaining smokers. An experimental group (performing exercise plus video watching, n=42) and two control groups (video watching only, n=18 and 'waiting passively' n=18) were randomly formed. Both control and exercise conditions lasted 20 min and the desire to smoke and withdrawal symptoms were assessed before, during and after 10 min of moderate intensity exercise on a stationary cycle, or after waiting passively or

watching a video. The positive effect of exercise is evident in the experimental group at all measurement points and maintained for at least 10 minutes following exercise. Similarly, Daniel et al. (2004) analyze the effect of 5 minutes of exercise on tobacco withdrawal symptoms among sedentary smokers. In particular, the participants to the experiment were randomly divided into three groups: light intensity exercise [n=28; 10–20% of heart rate reserve (HRR)], moderate intensity exercise (n=28; 40–60% HRR) and a passive control condition (n=28). The study highlights that only 5 minutes of moderate intensity exercise significantly reduces the desire of smoke, as well as the restlessness, stress, tension and poor concentration, while this is not the case for light intensity exercise and passive control condition.

Taylor et al. (2005) examine the effects of a 1-mile self-paced walk on different measures of urges to smoke after a temporary smoking abstinence. The participants to the experiment (n=15) between 18–50 years of age were engaged one day in exercise and another day sat quietly, without reading materials, for 40 minutes. The strength of desire to smoke is assessed by using a single-item measure (West et al., 1985) and controlled during, immediately post, and at 10 and 20 min post-treatment. Furthermore, to check for order effects, the individuals were randomly assigned (by random numbers) to begin either with a walking or in a passive condition. The repeated-measures ANOVA show that walking for a mile (or approximately 17 min) at a preferred intensity, reduces the urges to smoke and the authors highlight "the positive effects of low intensity exercise on urge to smoke lasting beyond the period of exercise, and certainly as long as 20 min post-treatment".

Daniel et al. (2006) show that the reduction in smoking desire due to moderate aerobic exercise is not caused by neither the distracting effect of exercise or the effects of mood. Forty smokers 16 to 65 years aged, sedentary and without psychiatric treatments, were recruited and randomly assigned to one of the two following groups: one completed 10 minutes of moderate intensity exercise on a stationary bicycle ergometer, while the other was involved in 10 minutes of a cognitive distraction task. Withdrawal symptoms and desire to smoke were measured using standard scales at 10, 5 and 0 minutes before the intervention, then at 5 and 10 minutes after the start of the intervention and 5 and 10 minutes after its completion. The experimental design underlines a reduction in irritability, depression, restlessness,

difficulty for concentrating and stress in the group performing a brief bout of moderate intensity exercise; on the contrary, differences in the desire to smoke and in withdrawal symptoms were not observed in the group engaged in cognitive distraction activity alone.

The effect of isometric - rather than aerobic - exercise on the desire to smoke is discussed by Ussher et al. (2006). Smokers from 16 to 65 years old, not receiving psychiatric treatments, non pregnant, not making any attempt to quit smoking were randomly assigned to 5 minutes of: i) isometric exercise condition (*n*=20), based on static muscular contractions ,ii) body scanning (*n*= 20) related to the sensation in five areas of the body and iii) sitting passively (*n*=20). Tobacco withdrawal symptoms such as "irritable" state, "depressed" or "stressed" state, and the desire to smoke were analysed before, just at the end of the intervention, and 5, 10, 15 and 20 after, and compared to baseline. The study points out that a five minutes of seated isometric exercise provides a higher relief from the desire to smoke compared to passive control condition. Differently, from the comparison of isometric exercise and body scanning groups, there is no evidence that isometric exercise has a moderating effect on desire to smoke. This result suggests that the positive effect of isometric exercise on desire to smoke could be due to the distraction. Anyway, the effect of aerobic activity on the desire to smoke (Ussher et al., 2001; Daniel et al., 2004; Taylor et al., 2005) is more pronounced than for isometric exercise. Ussher et al. (2007) also investigate whether the physical activity counselling increases the long-term smoking abstinence. Both male and female smokers 18 to 65 years aged, smoking at least 10 cigarettes per day for at least 3 years, were randomly assigned to two alternative 7-week smoking cessation program. The first program includes 5 minutes of cognitive-behavioural physical activity counselling ('exercise', *n*=154) during which the participants were advised to progress towards 30 minutes of at least moderate physical activity, for at least five days a week (Department of Health, 2004). In the other program, the participants received health education advices ('control', *n*=145) on healthy eating, fat and salt intake, alcohol consumption and stress management. Both the groups received a nicotine replacement therapy. Smoking information was collected at baseline: Fagerström Test of Nicotine Dependence (FTND, Heatherton et al., 1991), the four-item Perceived Stress Scale (PSS4, Cohen et al., 1983) and a rating of confidence for quitting smoking (West et al., 1998). A comparison between the

baseline characteristics of the two groups was carried out using the analysis of variance (ANOVA) and chi-squared (χ^2) tests. Differences in smoking abstinence were assessed by X^2 tests: after 12 months of the treatment, the exercise group and the control one do not present a significant difference in the rates of continuous smoking abstinence (39.6%, 61/154 in exercise group versus 38.6%, 56/14 for the control group). The logistic regression outlines that abstinence at 12 months were significantly predicted by lower levels of depression during the first week of abstinence.

The effects of walking on the desire to smoke and withdrawal symptoms are investigated by Katomeri et al. (2006). The study was conducted on a sample of "17 males and 13 females, aged 21.9 (SD = 2.1) years, smoking 13.7 (SD = 4.3) cigarettes daily". After 2 hours of abstinence, the individuals were divided in a control and a treatment group; the smokers in the first group remained seated for 10 minutes, while the smokers in the second group were committed to do a brisk self-paced treadmill walk. A series of repeated test Anova performed on one measure of desire to smoke (Tiffany et al., 1991) and seven indicators of Mood and Physical Symptoms Scale (West et al., 1985) point out significantly lower measures following exercise than the control condition, relative to baseline. In addition, a first cigarette was smoked significantly later by individuals engaged in the exercise than by people in the control group (66 minutes versus 31 minutes).

The longitudinal relationship between physical activity and smoking among the adolescents is investigated by Audrian-McGovern et al. (2003). The final sample, of which 60% women, includes 978 high school students in northern Virginia, who completed the responses during four data collection waves (from grade 9 to grade 11). Smoking behaviour was evaluated by an order categorical variable assuming five categories indicating an increasing level of smoking; the frequency and duration of physical activity, in addition to aerobic and anaerobic exercise, was assessed by a continuous variable with values between 0 (no physical activity) and 24 (high participation in physical activity). The analysis was performed by a special form of structural equation modelling - latent growth modelling (LGM) - that "assesses individual growth curves, averaging trends (slopes) and levels (intercepts) to evaluate the fit of general growth patterns to the data". The model includes gender, race, baseline depression and participation in physical activity at school (mandatory for students at baseline) to avoid that the effect of physical activity on smoking could be confused by

participation in physical activity at school. The study highlights that physical activity trend has a direct and negative effect on smoking progression in the adolescents, while the reverse was not true:" changes in smoking did not predict changes in physical activity".

The relation between exercise and desire to smoke is also analyzed among abstaining adolescent smokers (Everson et al., 2006). The experiment is carried out on thirty-seven young people, 16-19 years aged, exercising no more than twice per week. The participants were assigned to the following groups: i) 10 minutes of moderate intensity cycle ergometry (n=18), or ii) a placebo control condition, in which the individuals completed 10 minutes of very low-intensity exercise on a stationary cycle. The placebo control condition was preferred to passive condition to avoid that the different environmental conditions of the participants could influence the results; in this way, the aerobic stimulus was the only variable that distinguished the two conditions. Desire to smoke, The Mood and Physical Symptoms scale (MPSS) and Subjective Exercise Experience Scale (SEES; McAuley et al., 1994) were assessed at baseline, 5 minutes during experiment, 5 minutes after and 30 minutes after both conditions. In particular, SEES contains a list of 12 adjective measuring changes in positive wellbeing, psychological distress and fatigue. Repeated-measures ANCOVAs, with the baseline values as covariates, underline that moderate exercise did not affect the desire to smoke and withdrawal symptoms: in addition, a higher psychological distress score was reported by people involved in the moderate exercise than for the control group. The authors suggest that, probably, ten minutes of moderate exercise are not enough to have a significant effect on desire to smoke and depression, irritability and the other emotional symptoms among younger smokers.

Interestingly, the relation between physical activity in adolescence and smoking in adulthood is estimated by a prospective twin cohort study (Kujala et al., 2007). The analysis on twins allows controlling for both known and unknown familiar factors like childhood environment and genetic disposition. A causal relation between high physical activity and low smoking is presumably established. The sample includes twins from consecutive birth cohorts identified from the Central Population Registry of Finland. Three adolescent questionnaires were completed by twins at age 16, 17 and 18.5 years: individuals reporting a high frequency of physical activity (4-5 times a week or more) were considered persistently active at baseline, those doing exercise 1-2 times a month or less were defined as inactive (at

baseline), the others were described as occasionally active. Furthermore, smoking habit was assessed at baseline (within two months of 16th birthday): adolescents were asked if they had ever smoked and, if so, how many cigarettes they had smoked. In particular, a categorical variable with 4 values (never smokers, quitters, at least weekly smokers and occasional smokers) was used and those who had smoked up to that time more than 50 cigarettes were excluded from the analysis. Similarly, the follow-up information on physical activity and smoking behaviours were collected through a questionnaire sent to the twins 22-27 aged. Smoking status was transformed into a binary variable: those who smoked from 20 to 9 cigarettes per day were considered daily smokers, non-daily smokers otherwise. Logistic regression was carried out to estimate the relation between physical activity at baseline and follow-up smoking; importantly, twin pairs reporting different smoking behaviours at follow-up and categories of exercise at baseline were analysed to determine whether physical activity level at baseline affected the smoking status at follow up (after controlling for educational level and shared family environments). The estimates show that "persistent physical inactivity, compared to persistent physical activity during late adolescent, predicted higher prevalence of smoking during young adulthood". These results are similar to those reported by Escobedo et al. (1993) who, based on a nationally representative sample of US high school student, outline that sports participation may affect smoking behaviour: students who had been involved in interscholastic sports were less likely to be regular and heavy smokers than those who had not participated.

Some studies focus on the relation between physical activity and smoking among women as smoking rates decrease more slowly in men than in women (Escobedo et al., 1996).
A randomized control trial was carried out on 281 healthy, sedentary women 16 - 64 years old who had smoked 10 or more cigarettes per day for at least three years (Marcus et al., 1999). They were part of a 12-week smoking cessation program and randomly divided in two groups: i) cognitive - behavioural smoking cessation programme with staff contact time based on lectures, films, discussions on healthy eating and prevention of cancer and cardiovascular diseases (control condition), ii) cognitive-behavioural smoking cessation programme in addition to regular, vigorous physical activity, involving 3 exercise sessions per week (at the target heart rate between plus 60 to 85% of heart rate reserve) supervised by

an exercise specialist (exercise condition). The efficacy of the treatment condition, controlling for the programme attendance, was assessed by multiple logistic regressions; the estimates show that women in the exercise condition were 35% (16%- 75%; *p-value<0.01*) and 34% (15%-78%; *p-value=0.01*) less likely to have relapsed, respectively, at the end of the programme and after three months of the treatment compared to those in cognitive control condition. In addition, the results outline that the likelihood of relapse was significantly lower (36%, *p-value=0.03*) to 12 months after the treatment in the exercise group than in control condition. Importantly, the authors also point out that the reasons why other studies do not find a positive effect of physical activity on smoking habit (such as in Hill, 1984; Russell et al., 1988; Taylor et al., 1988) are most likely due to small simple sizes, poor and inadequate duration of the exercise training.

More recently, Ciccolo et al. (2011) investigate the use of resistance training (RT; i.e. weight lifting) as a strategy for quitting smoking for both men and women. Participants to the programme were smokers (≥5 cigarettes/day ≥1 year) aged between 18-65 years, not involved in regular physical activity, not reporting chronic diseases; pregnant women and individuals already not part of a smoking cessation treatment were excluded, too. Before starting treatment, individuals received a 15 to 20 minutes smoking cessation counselling session and were given a box of an 8-week supply of nicotine patches, the first was to apply the morning of quit day. Participants (*n*=25) were randomly assigned to: i) a resistance training condition, consisting of two 60-min RT sessions/week for 12 weeks (the weight was systematically increased by a researcher to maintain intensity during the treatments) or ii) contact control condition (CC) asking the participants to watch a video, twice/week, about health-related issues. Importantly, nicotine dependence (Heatherton et al., 1991), nicotine withdrawal symptoms (West et al., 2004), and perceived ability to quit (Etter et al., 2000) were measured at baseline. The effect of the RT sessions on the odds of being quit at 3-month and the 6-month follow-up were assessed by logistic regressions. Considering that nicotine patch use was similar for both groups, the estimates show that, after three months, objectively verified 7-day point prevalence abstinence (PPA) rates were 46% for the treatment group and 17% for the control one and prolonged abstinence rates were 16% and 8%, respectively. After 6 months, PPA rates were 38% for the RT group and 17% for CC (prolonged abstinence rates 16% and 8%, respectively).

3.2.2 Physical activity and eating habits

Few studies examine the relationship between physical activity and diet composition.

Simoes et al. (1995) use data from 1990 Behavioural Risk factor Surveillance System, a survey carried out to monitor health behaviour in U.S.. To control for the exercise behaviour of respondents, individuals (n=29.672) were divided in four categories: i) inactive, ii) irregularly active (duration<20 minutes or frequency<3/week), iii) regular not intense (duration>20 minutes and frequency ≥3/week), iv) regular intense (duration, frequency and intensity meeting the recommendations). The eating behaviour was based on 13-item questionnaire (about the consumption of hot-dog, lunch meats, bacon, sausage, fried chicken and so on). Logistic regression analysis included age, marital status, education, race, body mass index, smoking, alcohol intake, and cholesterol screening, which could affect both exercise and dietary fat. The estimates show that the fat consumption markedly decreases among both physically active men and women, compared to those inactive.

Similarly, Pate et al. (1996) outline an association between low physical activity and no consumption of fruit among White and Hispanic students; on the contrary, no differences were found among African-American students. Another study shows that sedentary individuals eat more irregularly and are more likely to skip breakfast compared to more active ones (Kannas, 1981) and The Canada Fitness Survey (1983) outlines that "among adults, 51% of the active, 45% of the moderately active, and 43% of the sedentary eat a good breakfast".

3.2.3 Remarks

The several studies reviewed in the previous sections show an association between physical active lifestyle and the adoption of other healthy behaviours. Certainly, the associations outlined by cross sectional surveys should be interpreted with caution. It is not possible determining whether physically activity influence in a causal way the smoking probability or the choice of a healthy diet. In addition, it is likely that some people may have over-reported physical exercise and/or underreported the adoption of objectionable lifestyles. Moreover, it could not be excluded that the time spent for doing physical activity affects the time available for other lifestyles.

Some of these limitations are addressed by the experimental studies which aim, mostly, to establish a causal relationship between the exercise interventions and the likelihood of quitting smoking. In some experimental trials, the individuals are randomly assigned to a treatment group, and engaged in physical activity whose duration and physical effort is monitored by the experts; or included into a control group, among individuals sitting peacefully, and/or involved in health education programme. In other studies, they are exposed to a light physical activity to avoid any effect related to the different environmental conditions of the participants. Although the studies remarkably differ for length, type, exercise timing and activities type, it is generally suggested that physical activity affects the probability of quitting smoking. In particular, the trials that do not find a significant effect of exercise on smoking abstinence are affected by numerous methodological limitations (Ussher et al., 2000), such as small samples and limited physical activity, both in terms of duration and effort, administered to the treatment group.

Importantly, also the experiments carried out on adolescents underline that "persistent physical activity seem be an important factor in the causal pathway in selecting and maintaining non-smoking behaviour" (Kujala et al., 2007). Furthermore, Audrain-Mcgovern et al. (2003) emphasize that, although the study is not able to determine with certainty a causal relation between exercise and smoking progression (because the data do not allow to establish if physical activity was present before adolescents reported a progression in smoking), it is certainly suggested that a change in physical activity predicts changes in smoking behaviour, while a change in smoking does not predict changes in physical activity.

On the other hand, the studies based on the relation between an active lifestyle and diet habits, are only able to suggest a positive association between exercise and diet.

Considering the results highlighted by the literature review, which focuses mainly on controlled trials, it makes sense to try determining a causal effect of physical activity on the smoking probability or the choice of an healthy diet for a representative sample of the general population.

3.3 RELATIONSHIPS BETWEEN PHYSICAL ACTIVITY, NO-SMOKING AND HEALTHY DIET IN ITALY

3.3.1 Economic framework

The health production model proposed by Grossman (1972) will be the economic framework used for the empirical analysis between the physical activity and other healthy habits. This model was used in the chapter 2 for other economic analysis and it will be hereafter specialized to investigate the relations between healthy lifestyles.

This model assumes that the stock of the initial health depreciates with age, and the individuals preserve their health, making choices in terms of use of medical services and the adoption of healthy behaviours, both subject to time and monetary budget constraints. It is possible describing the health production function as $H_t(H_{t-1}, L_t, M_t, Z_{t,}, N_t, E_t)$, where H_t is the stock of health, H_{t-1} is existing health stock, L_t includes choices about lifestyles, Z_t refers to non medical purchased good, N_t is a vector of environmental inputs, and E_t is education. The effect of lifestyles on the stock of health is not immediate. Physical activity and healthy diet may decrease or increase the current utility, but are supposed to increase the stock of health. On the contrary, smokers could get a current utility from smoking, but face a reduction of the health over the years. Moreover, it is very likely that the adoption of a health habit may be related to choices about other lifestyles. In fact, in several studies - analyzed in the second chapter - based on the relationships between medical care and bad lifestyles, the authors emphasized the importance to introduce other bad habits among the explanatory variables. This is because bad health behaviours are often themselves positively correlated (Manning et al., 1991). Despite the widespread perception that the lifestyles are correlated, there are few studies that seek to find a causal relationship among lifestyles. Thus, this chapter will try to assess a causal relationship between physical activity, non-smoking habit and healthy diet. In this way, it will be possible to better understand the direct effect of physical activity on the stock of individual health, and also the indirect effect through the influence on the adoption of other lifestyles.

3.3.2 Empirical model, identification problem and data description

The effect of regular and moderate-intensive leisure physical activity (LTPA) on non-smoking and healthy diet is assessed using the following specification:

$$LTPA_i = \alpha SM_i + \beta\, SD_i + \delta Z_i + e_i \qquad (11)$$

where $LTPA_i$ indicates if individual performs regular weekly physical exercise; in particular, $LTPA_i$ is a dummy variable equals to 1 if the individual does moderate physical activity for a minimum of 30 minutes on five days each week and/or they are involved in vigorous exercise for a minimum of 20 minutes on three days each week. These measures for Leisure Time Physical Activity are similar to those suggested by the American College of Sports Medicine and the American Heart Association[13] (Haskell et al., 2007) and by the surveillance PASSI.

The variable SM_i controls for the smoking status of the respondents and SD_i captures the individual's choices regarding diet (with a little salt, fat and so on). Z_i is a vector of control variables that contains sex, education, age, marital status, socio-professional status, family economic resources, area of residence and the health conditions of respondents. In particular, Z_i includes regressors that allow controlling for the intensity of physical activity during the homework and work hours (this latter information is available, of course, only for the employed). Those variables are included in the estimates because they may reasonably be expected to influence the engagement of individuals in LTPA. Lastly, e_i refers to the error term normally distributed. Most of the variables used in this section are similar to those used in the second chapter; however, in this chapter, the analysis is carried out on the data of the "file B" - including geographical distribution and domain code. In particular, table 3.1 reports the variables used in this chapter with the related statistics (number of observations, mean and standard deviation).

As mentioned earlier, an identification problem arises because decisions concerning the

[13] In particular, Haskell et al. (2007) outline that " to promote and maintain health, all healthy adults aged 18 to 65 yr need moderate-intensity aerobic (endurance) physical activity for a minimum of 30 min on five days each week or vigorous-intensity aerobic physical activity for a minimum of 20 minutes on three days each week. Combinations of moderate- and vigorous-intensity activity can be performed to meet this commendation".

adoption of healthy lifestyles are correlated with some unobservable variables, such as inter-temporal preference, genetic predispositions, environment conditions, risk propensity of individuals; as a consequence, physical activity is a potentially endogenous variable and, a proper identification of the model is essential to try establishing a causal relation between exercise and other healthy lifestyles.

Table 3.1. Variable description and summary statistics.

Outcome variables	**Description**	Mean	S.D.	No. of obs.
Controls				
Health behaviours				
Physical activity	1= moderate and/or vigorous physical activity, 0 otherwise	.178	.382	72348
Special diet	1 =person follows a special diet, 0 otherwise	.118	.323	124729
Non-smoker	1= person currently does not smoke, 0 otherwise	.178	.410	107926
Predisposing variables				
Sex	1 if female, 0 otherwise	.510	.499	124729
Age	Age of respondent	42.183	22.899	124729
Age2	Age at squared	2303.855	2.30.178	124729
Illiterate	1 if no educational certificates, 0 otherwise	.095	.294	124729
Primary school	1 if primary school certificates, 0 otherwise	.227	.419	124729
Lower high school	1 if lower school certificate, 0 otherwise	.283	.452	124729
High School	1 if high school certificate, 0 otherwise	.266	.442	124729
University	1 if university certificate, 0 otherwise	.065	.245	124729
Postgraduate degree	1 if PhD certificate, 0 otherwise	.005	.072	124729
Marital status				
Single	1 if never married, 0 otherwise	.342	.474	124729
Married	1 if currently married, 0 otherwise	.477	.499	124729
Separated/divorced	1 if currently separated or divorced	.044	.205	124729
Widowed	1 if widowed, 0 otherwise	.137	.343	124729
Kids	1 if individual has children, 0 otherwise	.691	.462	124729
Weight				
Under weight	1 if individual is under weight (BMI≤18.49), 0 otherwise	.028	.1667	124729

Outcome variables	**Description**	Mean	S.D.	No. of obs.
Normal weight	1 if individual is normal weight (18.50≤BMI<25), 0 otherwise	.433	.495	124729
Overweight	1 if individual is overweight (25≤BMI<30), 0 otherwise	.284	.451	124729
Obese	1 if individual is obese (BMI≥30), 0 otherwise	.255	.436	124729
Control weight	1 if person checks the weight daily or several times during the week, 0 otherwise	.193	.395	124729
Intensity physical activity at work				
Poor	1 if physical activity during the work is poor, 0 otherwise	.330	.470	48729
Moderate	1 if physical activity during the work is moderate, 0 otherwise	.449	.497	48729
Heavy	1 if physical activity during the work is heavy, 0 otherwise	.219	.414	48729
Intensity physical activity during housework				
Poor	1 if physical activity during housework is poor, 0 otherwise	.291	.454	76337
Moderate	1 if physical activity during housework is moderate, 0 otherwise	.607	.488	76337
Heavy	1 if physical activity during housework is heavy, 0 otherwise	.101	.302	76337
Self-assessed family income				
Excellent	1 if person lives in a family with excellent economic resource, 0 otherwise	.036	.187	124729
Fair	1 if person lives in a family with fair economic resources, 0 otherwise	.654	.475	124729
Insufficient	1 if person lives in a family with insufficient economic resource, 0 otherwise	.264	.441	124729
Absolutely insufficient	1 if person lives in a family with absolutely insufficient economic resources, 0 otherwise	.207	.045	124729
Tenure status of the dwelling				
Rent	1 if person lives in a rented house, 0 otherwise	.168	.374	124729
Estate	1 if person lives in a house he/she owns, 0 otherwise	.756	.430	124729
Usufruct	1 person lives in a house with the right of usufruct, 0 otherwise	.017	.128	124729
Other	1 for person in other condition	.059	.236	124729

Outcome variables	**Description**	Mean	S.D.	No. of obs.
Villa	1 if person lives in a villa, 0 otherwise	.159	.365	122109
Socio-professional status[14] and working hours				
Unemployed	1= person non-working during last week, 0 otherwise	.564	.496	106320
Self-worker	1= person is self-employed, 0 otherwise	.244	.429	46581
Manager	1= person is a manager, 0 otherwise	.074	.262	46581
Skilled non-manual	1= person is a skilled non-manual worker, 0 otherwise	.309	.462	46581
Manual	1= person is a manual worker, 0 otherwise	.337	.473	46581
Other jobs	1=person for other jobs, 0 otherwise	.035	.185	46581
Working hours	number of hours effectively worked per week	39.85042	12.02624	48729
Working hours squared	squared number of working hours	1732.683	1061.242	48729
Area of birth[15]				
Piemonte	1= person is born in Piemonte, 0 otherwise	.006	.078	124729
Valle Aosta	1= person is born in Val D'Aosta, 0 otherwise	.000	.012	124729
Lombardia	1=person is born in Lombardia, 0 otherwise	.010	.098	124729
Trentino Alto-Adige	1= person is born in Trentino, 0 otherwise	0	0	124729
Bolzano	1= person is born in Bolzano, 0 otherwise	.001	.031	124729
Trento	1= person is born in Trento, 0 otherwise	.001	.033	124729
Veneto	1=person is born in Veneto, 0 otherwise	.010	.098	124729
Friuli Venezia Giulia	1= person is born in Friuli Venezia Giulia, 0 otherwise	.029	.169	124729
Liguria	1= person is born in Liguria, 0 otherwise	.003	.053	124729
Emilia Romagna	1= person is born in Emilia Romagna, 0 otherwise	.005	.069	124729
Toscana	1=person is born in Toscana, 0 otherwise	.004	.062	124729
Umbria	1= person is born in Umbria, 0 otherwise	.002	.050	124729
Marche	1= person is born in Marche, 0 otherwise	.002	.050	124729
Lazio	1= person is born in Emilia Romagna, 0 otherwise	.007	.085	124729

[14] Variables related to the sector of activity of the individuals are included in the estimates but the summary statistics are not shown.

[15] 87.383 individuals reside, at the date of the interview, in the same region of birth.

Outcome variables	**Description**	Mean	S.D.	No. of obs.
Abruzzo	1=person is born in Abruzzo, 0 otherwise	.003	.056	124729
Molise	1= person is born in Molise, 0 otherwise	.001	.037	124729
Campania	1= person is born in Campania, 0 otherwise	.016	.125	124729
Puglia	1=person is born in Puglia, 0 otherwise	.011	.107	124729
Basilicata	1=person is born in Basilicata, 0 otherwise	.003	.055	124729
Calabria	1= person is born in Calabria, 0 otherwise	.009	.095	124729
Sicilia	1=person is born in Sicilia, 0 otherwise	.012	.109	124729
Sardegna	1=person is born in Sardegna, 0 otherwise	.003	.059	124729
Geographical distribution and size of municipalities where the individuals live				
North-western Italy	1=person lives in a region of North-western Italy, 0 otherwise	.211	.408	124729
North-eastern Italy	1= person lives in a region of North-eastern Italy, 0 otherwise	.201	.401	124729
Central Italy	1= person lives in a region of Central Italy, 0 otherwise	.177	.381	124729
Southern Italy	1= person lives in a region of Southern Italy, 0 otherwise	.298	.457	124729
Islands	1= person lives in a one of the two Italian islands, 0 otherwise	.113	.316	124729
Municipalities near the metropolitan area	1 person if resides in municipalities near the metropolitan area, 0 otherwise	.105	.306	124729
Municipalities at the periphery of metropolitan area	1 if person resides in municipalities at the periphery, 0 otherwise	.091	.288	124729
Municipalities with up to 2,000 inhabitants	1 if person resides in municipalities with up to 2,000 inhabitants, 0 otherwise	.089	.285	124729
Municipalities with 2.001-10.000 inhabitants	1 if person resides in municipalities with 2.001-10.000 inhabitants, 0 otherwise	.297	.457	124729
Municipalities with 10.001-50.000 inhabitants	1 if person resides in municipalities with 10.001-50.000 inhabitants, 0 otherwise	.254	.435	124729
Municipalities with over 50,000 inhabitants	1 if person resides in municipalities with over 50,000 inhabitants, 0 otherwise	.163	.369	124729
Activity limitations and disability				
Limitations	1=person reports limitation from six months, 0 otherwise	.158	.365	124729
Disability	1= person reports some	.04703	.212	124729

Outcome variables	**Description**	Mean	S.D.	No. of obs.
	disability, 0 otherwise			
Accidents	1=person reports having had accidents in the last four weeks, 0 otherwise	.027	.162	124729
Use of rehabilitation services	1=person reports to use rehabilitations services in the last 3 months	.036	.185	124729
Blindness	1 = person is blind, 0 otherwise	.007	.081	124729
Deafness	1= person is deaf, 0 otherwise	.001	.038	124729
Motor disability	1=person suffers from motor disabilities, 0 otherwise	.038	.172	124729
Mental deficiency	1=person suffers from mental deficiency, 0 otherwise	.009	.096	124729
Mental illness	1=person suffers from mental illness, 0 otherwise	.009	.097	124729
Health and chronic conditions				
Index of the physical state	Physical Component score - Health related quality of life instrument Short Form	50.165	9.553	107926
Index of mental state	Mental Component Score - Health related quality of life instrument Short Form	49.821	9.690	107926
Asthma	1= person suffers from asthma, 0 otherwise	.054	.226	124729
Allergies	1= person suffers from allergies, 0 otherwise	.113	.317	124729
Diabetes	1= person suffers from diabetes, 0 otherwise	.045	.208	124729
Emphysema	1=person suffers from emphysema, 0 otherwise	.047	.212	124729
Hypertension	1=person suffers from hypertension, 0 otherwise	.154	.361	124729
Heart attack	1=person has suffered from heart attack, 0 otherwise	.017	.131	124729
Other heart disease	1=person suffers from other heart disease	.039	.195	124729
Angina	1=person suffers from angina pectoris, 0 otherwise	.011	.106	124729
Stroke	1= person has suffered from stroke, 0 otherwise	.011	.107	124729
Osteoporosis	1=person suffers from osteoporosis, 0 otherwise	.054	.225	124729
Cancer	1= person suffers from cancer, 0 otherwise	.022	.146	124729
Migraine	1= person suffers from migraine, 0 otherwise	.100	.300	124729
Depression	1=person suffers from depression, 0 otherwise	.075	.264	124729
Endocrine disease	1= person suffers from endocrine disease, 0 otherwise	.044	.205	124729
Skin disease	1=person suffers from skin disease, 0 otherwise	.011	.104	124729

Outcome variables	**Description**	Mean	S.D.	No. of obs.
Other chronic diseases	1=person suffers from other chronic disease, 0 otherwise	.046	.209	124729
June 2005	1= person had the interview during the months from June to August (2005), 0 otherwise	.250	.433	124729
Mean -LTPA		.144	.164	95642

Note: S.D. stands for standard deviation.

3.3.3 Recursive probit model

Recursive probit regressions are carried out to estimate weather regular leisure time physical activity significantly affects the probability of not smoking and the likelihood to adopt a healthy diet.

In particular, the latent variables related to the non-smoking habit, healthy eating and the engagement in regular leisure time physical activity are specified as follows:

$$Y_1^* = \beta_1 X + Z_1 + \varepsilon_1 \quad (12)$$

$$Y_2^* = a_1 Y_1 + \gamma_1 X + \varepsilon_2 \quad (13)$$

The observed outcomes are:

$Y_1 = 1$ if $Y_1^* > 0$, 0 otherwise

$Y_2 = 1$ if $Y_2^* > 0$, 0 otherwise

where Y_1 = regular leisure time physical activity, Y_2 = no-cigarettes consumption, healthy diet.

Z_1 refers to the exclusion restrictions necessary to identify the equations for non-smoking behaviour and healthy eating. Furthermore, the simultaneous equations model allows that the errors of the two equations, ε_1 and ε_2, are correlated (this correlation is expressed by the parameter "*p*"), as presumably in the case of unobserved heterogeneity.

On the other hand, it is assumed that non-smoking status does not influence the physical activity: not necessarily, individuals perform regular and moderate and/or vigorous physical activity just because they do not smoke. Broadly, a not smoking habit can improve the performance for those who have chosen to perform physical activity.

3.3.4 Instrumental variables: power and validity

To better identify the equations for non-smoking status and healthy eating, it is useful to introduce an exclusion restriction: at least one variable should be introduced in the equation for leisure time physical activity, while excluded from the equations for non smoking status and healthy diet.

Given that the engagement in physical activity is - at least partly - due to the climate, as weather conditions can encourage physical activity, such as walking, running, cycling, golf (Dannenberg et al., 1989), it is assumed that an instrumental variable related to LTPA is the period when the interview was conducted. In particular, *June 2005*, which refers to quarter including June, July and August of the survey interview, is the instrumental variable introduced to handle the potential endogeneity of physical activity. Similarly, Sarma et al. (2014) use average local temperatures during the months of the survey, to identify the causal ration between physical activity and health outcomes such as obesity and diabetes among Canadians.

The instrument for LTPA, to be considered valid, must be uncorrelated with non-smoking status and healthy diet. It is supposed that, the period when the interview was conducted, does not affect smoking habit of the respondents and the choice relating a healthy diet. Importantly, to avoid following a healthy diet may depend on the quarter of the interview, all the individuals who carry out a diet to lose weight (information included in the survey) are excluded from the estimates. In order to assess that the instrument is not correlated to smoking status and diet, two probit regressions are carried out in which, non-smoking and special diet are, respectively, are made to depend on the quarter of detection of the interview -*June 2005*- (in addition to all other variables). The estimates reported in table 3.2 outline that *June 2005* does not significantly affect smoking status and healthy diet. Furthermore, to estimate the power of the instrument, the Cragg Donald F statistics, the Kleibergen-Paap rk Lagrange multipier and the Kleibergen-Paap rk Wald statistics are reported.

Whereas the causal relationship between physical activity and the other lifestyles is highly dependent on the goodness of the instrument, it is considered useful estimating these relations using another instrumental variable. In particular, another instrument is built,

similar to that used in the second chapter, and called "*Mean-LTPA*": individuals doing LTPA of the same age and sex, living in the same geographical area and in municipalities of equal size are included in the reference group[16] of individual *"i"*. In this way, the engagement in LTPA is made to depend not only on the local temperatures that are, indirectly, captured by the geographical area of residence of individual *"i"*, but also by the availability of green spaces and gyms, highly related to the size of the cities and municipalities. On the other hand, it is supposed that the active/inactive lifestyle of the reference group does not affect directly the smoking status and the eating habit of the individual *"i"* and the estimates of the probit model shown in the **Table 3.2** confirm this hypothesis. Furthermore, Cragg Donald F-statistic, Kleibergen-Paap rk Lagrange multiplier and Kleibergen-Paap rk Wald statistics are also performed to evaluate the validity of this instrumental variable.

In addition, these above mentioned statistical tests, probit regressions and Hansen J statistic, are performed using both the instruments; in this way, it could be also tested the hypothesis that the instruments are jointly valid, because uncorrelated with the error term.

The main results are shown in **Table 3.2** and **Table 3.3**

Table 3.2. Relations of non-smoking and healthy diet and exclusion restrictions (main covariates).

	Probit regressions (main covariates)	
	Non smoking	Healthy eating
June 2005	-.011	-.007
	(.025)	(.035)
Mean- LTPA	.012	.170
	(.151)	(.217)

Notes: Robust SEs are displayed in parentheses. Significance levels: * $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.01$.

Table 3.3. Summary results for first-stage regressions.

Instruments for LTPA	***June 2005***	***Mean-LTPA***	***June 2005 and Mean-LTPA***
Cragg-Donald Wald F-statistic	17.44 ***	691.32 ***	567.79 ***
Keibergen-Paap LM-statistic	16.20***	462.861***	758.54***
Kleibergen-Paap rk Wald statistic	16.13***	533.929 ***	442.550 ***
Hansen J statistics	-	-	0.462 *p-value* = 0.4966

Notes: Significance levels: * $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.01$.

[16] The reference group of individual consists of at least 10 people.

The Cragg-Donald Wald statistics outline that both *June 2005* and *Mena-LTPA* are highly correlated to the endogenous variable: they exceed the threshold highlighted by Staiger and Stock (1997).

Similarly, Keibergen-Paap LM and Kleibergen-Paap rk Wald are tests of under identification and the reported statistics confirm that the excluded instruments are relevant, correlated with the endogenous regressors. Importantly, Hansen J statistic, based on the assumption that at least one instrument is exogenous, outlines that the exclusion restrictions are appropriate because not correlated with the error term, and then with unobserved variables such as individual time preferences.

To summarize, the estimates and the tests carried out suggest that the instruments are valid and that a causal effect of regular LTPA on other healthy behaviours can be reasonably assessed.

3.3.5 Empirical results

The main results of the second equation of the recursive probit models are shown in **Table 3.4** and **Table 3.5**. In particular, to address the relations between physical activity and non-smokers and physical activity and healthy eating, three recursive probit regressions are, respectively, carried out; in the first regression, *June 2005* is used as exclusion restriction; while, in the second, *Mean-LTPA* is included in the equation for LTPA, and in the last regression, both the instruments are used to manage the potential endogenity of LTPA.

Table 3.4. Estimated average marginal effects of the second equations of the Recursive probit model (main covariates). Physical activity and non-smokers.

Pr(non-smoker=1, LTPA=1)			
	Estimates with *June 2005* as exclusion restriction	Estimates with *Mean-LTPA* as exclusion restriction	Estimates with *June 2005* and *Mean-LTPA* as exclusion restriction
LTPA	.038***	.021***	.021***
	(.009)	(.006)	(.006)
Estimated *p*	-.324***	-.141**	-.137**
	(.109)	(.068)	(.068)
Wald test of *p*	8.759***	4.283*	4.069**
Number of observations	16446	14316	14316
Degree of freedom	213	213	214

Pr(non-smoker=1, LTPA=1)			
	Estimates with *June 2005* as exclusion restriction	Estimates with *Mean-LTPA* as exclusion restriction	Estimates with *June 2005* and *Mean-LTPA* as exclusion restriction
Log-likelihood	-14670.33	-12482.62	-12477.09
AIC	29766.67	25391.23	25382.19
BIC	31408.44	27003.46	27001.98

Notes: Robust SEs are displayed in parentheses. Significance levels: * $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.10$.

Table 3.5. Estimated average marginal effects of the second equations of the Recursive probit model (main covariates). Physical activity and healthy diet.

Pr(healthy diet=1, LTPA=1)			
	Estimates with *June 2005* as exclusion restriction	Estimates with *Mean-LTPA* as exclusion restriction	Estimates with *June 2005* and *Mean-LTPA* as exclusion restriction
LTPA	.012***	.012***	.012***
	(.001)	(.001)	(.0015339)
Estimated *p*	-.184*	-.153*	-.153*
	(.107)	(.086)	(.085)
Wald test of *p*	2.938*	3.15*	3.223*
Number of observations	16446	14316	14316
Degree of freedom	213	213	214
Log-likelihood	-9413.209	-7857.37	-7851.557
AIC	19252.42	16140.74	16131.11
BIC	20894.19	17752.97	17750.91

Notes: Robust SEs are displayed in parentheses. Significance levels: * $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.10$.

Individuals doing regular LTPA are about 4% more likely to be non-smokers and about 1% more likely to follow a healthy diet, with reference to *June 2005* as exclusion restriction. This relationship is significant at the 1% level. Similarly, the estimates carried out using *Mean-LTPA* or both *Mean-LTPA* and *June 2005*, suggest a positive and significant effect of LTPA either on non-smoking habit or healthy eating; in particular, the individuals engaged in exercise are about 2% more likely to be non-smokers and around 1% eating in healthy way.

The endogeneity tests of *"rho"*(Knapp et al., 1998) suggest the presence of unobservable eterogeneity affecting the relations between exercise, smoking habit and healthy eating: it is preferable, to obtain unbiased results, to perform a recursive estimation than carrying out the equations separately. As it regards the information criteria to compare the three estimates, both Akaike's (AIC) and Schwarz's Bayesian information criteria (BIC) indicate that the regression including both *June 2005* and *Mean-LTPA* fits the data better than the regressions carried out with only one exclusion restriction.

3.4 DISCUSSION

Physical activity is one of non-medical inputs in the Grossman's household productions function and it is widely accepted that sedentary lifestyle is a risk factor for several chronic conditions, heart disease, stroke, arthritis and some types of cancer. To promote and maintain health it is recommend that individuals should be regularly engaged in moderate or/and vigorous physical activity (Haskell et al., 2007; Passi, 2014). However, the positive effects of exercise on the stock of health could be both direct, such as through the reduction of hypertension (Gorelick et al., 1999), but also have an indirect effect on health whether people involved in physical activity adopted more positive lifestyles. In particular, the correlation between lifestyles is well recognized in health economic literature but, because of unobservable factors like individual time preference and risk aversion, it is difficult to give a causal interpretation to the relations between lifestyles. In particular, many studies focus on the effect of physical activity on smoking behaviour; they are based on controlled trials conducted on sample of smokers and, in this case, the causal interpretation of the effect of exercise on smoking is allowed by randomization.

Taking into account the identification issue through the introduction of two instrumental variables in the recursive probit model, this study tries to give a causal interpretation to the relation between LTPA and non-smoking habit and healthy diet for a representative sample of the Italian population.

The estimates show that individuals doing regular and moderate/vigorous LTPA are significantly more likely to be non-smokers and following a healthy diet. It is relevant to highlight that the casual interpretation of these relations is only possible if the instruments are valid and not correlated with the error term, which includes unobservable variables.

The positive effect of LTPA on smoking habit are in line with the results shown by the several studies reviewed; probably, exercise may protect against smoking initiation or relapse influencing factor such as perceived coping ability (Steptoe et al., 1989), self-esteem

(Fox, 1999), and global physical-concept (Rodriguez et al., 2005). On contrary, the effect of LTPA on non-smoking habit is not due to the distraction effect, as pointed out by Daniel et al. (2006). Jointly considered, these studies support the causal interpretation of the relation between exercise and non-smoking.

As for the relation between LTPA and diet, this study also outlines a positive and significant effect of exercise on healthy eating. This relation is also emphasised by previous studies reporting that, although regular moderate/vigorous exercise is necessarily associated with increased intake, at least when weight is maintained, physically active people tend to follow a diet lower in fat compared to sedentary ones (Hovell et al., 1991; Hovell et al., 1989). Moreover, "exercise ha also a positive effect on mood, which may help support decreases in energy intake as well" (Sherwood et al., 2000).

The results of this study highlight the importance of intervention to encourage the practice of regular physical activity by the whole population. Considering that becoming a regular exerciser is not so easy because people have to adopt the belief that exercise confers enough benefits to outweigh its costs, it is essential a strong and joint intervention of politicians and professionals, especially of General Practitioners. The latter ones should emphasise the important role that physical activity plays in primary prevention, exerting several and positive effects to preserve the stock of health.

Policy makers could design specific interventions to increase physical activity, in particular among adult population. For example, as first step, they could extend the tax deduction for sport, currently reserved to family members aged 5-18, even for adults engaging in physical activity and also provide a highest tax deduction for families with low incomes. Moreover, whereas another barrier to access to physical activity is time, interventions aimed at providing the necessary sport equipment in the workplace, to ensure at least half an hour of exercise a day, could significantly increase the practice of LTPA among general population. Surely, these interventions will require additional funds, in a period already very critical to find resources. However, the positive effects on the costs borne by the National Health System, for diseases directly or indirectly related to physical inactivity, may be evident already in the medium term.

3.5 TABLES OF CHAPTER 3

Table 3.6. Coefficients estimates of the second equations of the recursive-probit model - Physical activity and non-smoking behaviour among adult Italian population.

Health behaviours	Estimates with *June 2005* as exclusion restriction	Estimates with *Mean-LTPA* as exclusion restriction	Estimates with *June 2005* and *Mean-LTPA* as exclusion restriction
LTPA	0.776***	0.482***	0.475***
	(0.168)	(0.117)	(0.116)
Other health behaviour			
Special diet	-0.016	0.030	0.031
	(0.047)	(0.047)	(0.047)
Predisposing variables			
Sex	0.415***	0.398***	0.397***
	(0.037)	(0.034)	(0.034)
Age	-0.029***	-0.029***	-0.029***
	(0.007)	(0.008)	(0.008)
Age2	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)
Education			
Illiterate	Reference Group	Reference Group	Reference Group
Primary school	-0.190**	-0.185*	-0.185**
	(0.084)	(0.088)	(0.088)
Lower high school	-0.201***	-0.172*	-0.172**
	(0.078)	(0.082)	(0.082)
High school	-0.093	-0.060	-0.060
	(0.079)	(0.084)	(0.084)
University	0.092	0.134	0.135
	(0.089)	(0.094)	(0.094)
PhD	0.030	0.096	0.097
	(0.157)	(0.174)	(0.174)
Marital status			
Widowed	0.023	-0.022	-0.022
	(0.076)	(0.080)	(0.080)
Separated/Divorced	-0.059	-0.066	-0.066
	(0.044)	(0.047)	(0.047)
Married	0.229***	0.207***	0.207***
	(0.032)	(0.033)	(0.033)
Single	Reference Group	Reference Group	Reference Group
Kids	0.096***	0.078***	0.078***
	(0.026)	(0.028)	(0.028)
Weight			
Under weight	-0.373***	-0.326***	-0.326***
	(0.070)	(0.075)	(0.075)
Normal weight	-0.217***	-0.194***	-0.194***
	(0.044)	(0.045)	(0.045)

Health behaviours	Estimates with *June 2005* as exclusion restriction	Estimates with *Mean-LTPA* as exclusion restriction	Estimates with *June 2005* and *Mean-LTPA* as exclusion restriction
Overweight	-0.087**	-0.077*	-0.076*
	(0.042)	(0.045)	(0.045)
Obese	Reference Group	Reference Group	Reference Group
Weight Control	0.030	0.064**	0.065**
	(0.035)	(0.032)	(0.032)
Intensity physical activity at work			
Poor	0.057	0.049	0.049
	(0.037)	(0.039)	(0.039)
Moderate	0.055*	0.039	0.039
	(0.029)	(0.032)	(0.032)
Heavy	Reference Group	Reference Group	Reference Group
Intensity physical activity during housework			
Poor	0.000	0.009	0.009
	(0.042)	(0.045)	(0.045)
Moderate	0.066*	0.076*	0.076*
	(0.038)	(0.040)	(0.040)
Heavy	Reference Group	Reference Group	Reference Group
Self-assessed family income			
Excellent	0.212**	0.210**	0.210**
	(0.086)	(0.093)	(0.093)
Fair	0.130**	0.127**	0.127**
	(0.060)	(0.065)	(0.065)
Insufficient	0.015	0.021	0.020
	(0.061)	(0.066)	(0.066)
Absolutely insufficient	Reference Group	Reference Group	Reference Group
Tenure status of the dwelling			
Estate	0.081*	0.082*	0.083*
	(0.043)	(0.046)	(0.046)
Rent	-0.060	-0.066	-0.065
	(0.047)	(0.051)	(0.051)
Usufruct	-0.094	-0.052	-0.051
	(0.098)	(0.108)	(0.108)
Other	Reference Group	Reference Group	Reference Group
Villa	-0.058**	-0.048	-0.048
	(0.030)	(0.032)	(0.032)
Socio-professional status			
Unemployed	0.097**	0.102**	0.102**
	(0.048)	(0.052)	(0.052)
Self-worker	0.016	0.028	0.028
	(0.062)	(0.067)	(0.067)
Manager/professional	-0.020	0.054	0.055
	(0.078)	(0.085)	(0.085)
Skilled non-manual	0.007	0.030	0.031
	(0.063)	(0.069)	(0.069)

Health behaviours	Estimates with *June 2005* as exclusion restriction	Estimates with *Mean-LTPA* as exclusion restriction	Estimates with *June 2005* and *Mean-LTPA* as exclusion restriction
Manual	0.009	0.003	0.003
	(0.060)	(0.065)	(0.065)
Other jobs	Reference Group	Reference Group	Reference Group
Sector of activity			
Agriculture, hunting, fishing	0.221**	0.183***	0.183***
	(0.054)	(0.056)	(0.056)
Mining, energy	-0.174	-0.163	-0.163
	(0.129)	(0.135)	(0.135)
Industry and manufacturing activities	-0.012	-0.011	-0.011
	(0.039)	(0.042)	(0.042)
Construction	-0.104**	-0.071	-0.072
	(0.052)	(0.055)	(0.055)
Trade	-0.001	-0.005	-0.005
	(0.040)	(0.044)	(0.044)
Hotels and restaurants	-0.060	-0.028	-0.029
	(0.060)	(0.065)	(0.065)
Transport, storage and communications	-0.029	-0.020	-0.020
	(0.060)	(0.066)	(0.066)
Monetary and financial intermediation	0.071	0.067	0.067
	(0.089)	(0.097)	(0.097)
Real estate, renting, computer science, research and other professional or business activities	-0.048	-0.020	-0.019
	(0.068)	(0.075)	(0.075)
Public administration and defence	-0.018	-0.006	-0.006
	(0.050)	(0.054)	(0.054)
Education	-0.059	-0.077	-0.077
	(0.053)	(0.057)	(0.057)
Health and other social services	-0.131***	-0.129**	-0.129**
	(0.048)	(0.052)	(0.052)
Others	Reference Group	Reference Group	Reference Group
Working hours	-0.003	-0.003	-0.003
	(0.003)	(0.004)	(0.004)
Working hours squared	-0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Area of birth			
Piemonte	-0.249	-0.410	-0.410
	(0.287)	(0.298)	(0.298)
Valle Aosta	-0.351	-0.574	-0.576
	(0.608)	(0.675)	(0.675)
Lombardia	-0.324	-0.449	-0.449
	(0.277)	(0.288)	(0.288)
Trentino Alto-Adige	Reference Group	Reference Group	Reference Group
Bolzano	-0.156	-0.362	-0.361
	(0.410)	(0.436)	(0.436)
Trento	-0.433	-0.598	-0.598
	(0.433)	(0.443)	(0.443)
Veneto	-0.177	-0.351	-0.350

Health behaviours	Estimates with *June 2005* as exclusion restriction	Estimates with *Mean-LTPA* as exclusion restriction	Estimates with *June 2005* and *Mean-LTPA* as exclusion restriction
	(0.289)	(0.299)	(0.299)
Friuli Venezia Giulia	0.220	0.365	0.365
	(0.260)	(0.269)	(0.269)
Liguria	-0.052	-0.132	-0.132
	(0.181)	(0.189)	(0.189)
Emilia Romagna	-0.127	-0.199	-0.199
	(0.165)	(0.175)	(0.175)
Toscana	(0.221	0.377*	0.378*
	(0.178)	(0.209)	(0.209)
Umbria	(0.019	0.100	0.100
	(0.243)	(0.286)	(0.286)
Marche	-0.197	-0.295	-0.295
	(0.222)	(0.226)	(0.226)
Lazio	-0.098	-0.103	-0.102
	(0.114)	(0.121)	(0.121)
Abruzzo	-0.257	-0.339*	-0.339*
	(0.166)	(0.199)	(0.199)
Molise	-0.328	-0.504	-0.505
	(0.298)	(0.324)	(0.324)
Campania	-0.235***	-0.199***	-0.199***
	(0.072)	(0.077)	(0.077)
Puglia	0.005	-0.022	-0.022
	(0.080)	(0.088)	(0.088)
Basilicata	-0.216	-0.186	-0.186
	(0.148)	(0.157)	(0.157)
Calabria	0.051	0.000	0.000
	(0.099)	(0.106)	(0.106)
Sicilia	-0.085	-0.144	-0.144
	(0.083)	(0.090)	(0.090)
Sardegna	-0.127	-0.253*	-0.253*
	(0.138)	(0.149)	(0.149)
Geographical distribution and size of municipalities where the individuals live			
North-western Italy	-0.063	-0.080*	-0.079*
	(0.041)	(0.048)	(0.048)
North-eastern Italy	-0.065	-0.065	-0.064
	(0.044)	(0.048)	(0.048)
Central Italy	-0.101**	-0.116**	-0.116**
	(0.042)	(0.048)	(0.048)
Southern Italy	-0.015	-0.040	-0.040
	(0.040)	(0.046)	(0.046)
Islands	Reference Group	Reference Group	Reference Group
Municipalities near the metropolitan area	0.081*	0.085*	0.084*
	(0.043)	(0.050)	(0.050)
Municipalities at the periphery of metropolitan area	0.084*	0.094	0.094
	(0.046)	(0.062)	(0.062)

Health behaviours	Estimates with *June 2005* as exclusion restriction	Estimates with *Mean-LTPA* as exclusion restriction	Estimates with *June 2005* and *Mean-LTPA* as exclusion restriction
Municipalities with up to 2,000 inhabitants	0.134***	0.156***	0.156***
	(0.046)	(0.058)	(0.058)
Municipalities with 2,001-10,000 inhabitants	0.052	0.063*	0.062*
	(0.034)	(0.036)	(0.036)
Municipalities with 10,001-50,000 inhabitants	0.047	0.055	0.055
	(0.034)	(0.036)	(0.036)
Municipalities with over 50,000 inhabitants	Reference Group	Reference Group	Reference Group
Activity limitations and disability			
Limitations	0.018	0.021	0.021
	(0.044)	(0.048)	(0.048)
Disability	0.043	0.063	0.063
	(0.185)	(0.191)	(0.192)
Accidents	-0.202***	-0.163**	-0.162**
	(0.065)	(0.069)	(0.069)
Use of rehabilitation services	0.024	0.039	0.039
	(0.064)	(0.068)	(0.068)
Blindness	-0.299	-0.188	-0.188
	(0.315)	(0.351)	(0.351)
Deafness	-0.093	-0.192	-0.192
	(0.330)	(0.383)	(0.383)
Motor disability	-0.023	-0.069	-0.069
	(0.107)	(0.117)	(0.117)
Mental deficiency	-0.209	-0.163	-0.164
	(0.329)	(0.375)	(0.375)
Mental illness	5.627***	5.474***	5.474***
	(0.131)	(0.157)	(0.158)
Health and chronic conditions			
Index of the physical state	-0.000	0.000	0.000
	(0.002)	(0.002)	(0.002)
Index of mental state	0.007***	0.007***	0.007***
	(0.001)	(0.001)	(0.001)
Asthma	0.030	0.022	0.022
	(0.054)	(0.058)	(0.058)
Allergies	0.110***	0.106***	0.106***
	(0.034)	(0.036)	(0.036)
Diabetes	0.145*	0.119	0.118
	(0.084)	(0.091)	(0.091)
Emphysema	-0.371***	-0.419***	-0.419***
	(0.068)	(0.073)	(0.073)
Hypertension	0.100**	0.096**	0.096**
	(0.041)	(0.044)	(0.044)
Heart attack	0.086	0.175	0.175
	(0.147)	(0.166)	(0.167)
Other heart disease	0.050	0.083	0.083
	(0.087)	(0.096)	(0.096)

Health behaviours	Estimates with *June 2005* as exclusion restriction	Estimates with *Mean-LTPA* as exclusion restriction	Estimates with *June 2005* and *Mean-LTPA* as exclusion restriction
Angina	0.026	0.038	0.038
	(0.186)	(0.212)	(0.213)
Stroke	0.129	0.103	0.103
	(0.236)	(0.254)	(0.255)
Osteoporosis	0.097	0.070	0.071
	(0.080)	(0.086)	(0.086)
Cancer	0.046	0.038	0.038
	(0.098)	(0.108)	(0.108)
Migraine	-0.065*	-0.063*	-0.063*
	(0.034)	(0.036)	(0.036)
Depression	-0.137***	-0.129***	-0.129***
	(0.045)	(0.049)	(0.049)
Endocrine disease	-0.023	-0.013	-0.013
	(0.050)	(0.053)	(0.053)
Skin disease	0.007	-0.114	-0.113
	(0.101)	(0.107)	(0.107)
Other chronic diseases	-0.017	-0.031	-0.031
	(0.049)	(0.053)	(0.053)
No opinion	Reference Group	Reference Group	Reference Group
Cons	0.432*	0.447*	.449*
	(0.237)	(0.259)	(0.259)
N	16446	14316	14316
Log-likelihood	-14670.33	-12482.616	-12477.09
Wald stat.	10083.94***	6680.81***	6754.55
AIC	29766.67	25391.23	25382.19
BIC	31408.44	27003.46	27001.98
Degree of freedom	213	213	214

Notes: significance levels: * $p\leq0.10$, ** $p\leq0.05$, *** $p\leq0.01$.

Table 3.7. Exogeneity test - H_0: $\rho = 0$, recursive probit models - non smoking.

Healthy behaviours	Estimates with *June 2005* as exclusion restriction			Estimates with *Mean-LTPA* as exclusion restriction			Estimates with *June 2005* and *Mean-LTPA* as exclusion restriction		
	$\hat{\rho}$	Test Z	*rho* Wald test	$\hat{\rho}$	Test Z	*rho* Wald test	$\hat{\rho}$	Test Z	*rho* Wald test
Non-smoking	-.32***	-2.96	8.76***	-.18*	-1.71	2.94*	-.13**	-2.02	4.07**

Notes: significance levels: * $p\leq0.10$, ** $p\leq0.05$, *** $p\leq0.01$.

Table 3.8. Coefficients estimates of the second equations of the recursive-probit model - Physical activity and healthy diet among Italian population.

Health behaviours	Estimates with *June 2005* as exclusion restriction	Estimates with *Mean-LTPA* as exclusion restriction	Estimates with *June 2005* and *Mean-LTPA* as exclusion restriction
LTPA	0.792***	0.737***	0.738***
	(0.196)	(0.153)	(0.152)
Other health behaviours			
Non-smoking	0.041	0.054	0.054
	(0.036)	(0.038)	(0.038)
Predisposing variables			
Sex	0.057	0.058	0.058
	(0.049)	(0.048)	(0.048)
Age	0.021**	0.018*	0.018*
	(0.010)	(0.011)	(0.011)
Age2	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Education			
Illiterate	Reference Group	Reference Group	Reference Group
Primary school	0.153	0.205	0.205
	(0.128)	(0.144)	(0.144)
Lower high school	0.155	0.247*	0.246*
	(0.122)	(0.137)	(0.137)
High school	0.245**	0.323**	0.323**
	(0.124)	(0.139)	(0.139)
University	0.190	0.241	0.241
	(0.133)	(0.149)	(0.149)
PhD	0.127	0.209	0.208
	(0.212)	(0.237)	(0.237)
Marital status			
Widowed	-0.198*	-0.160	-0.160
	(0.103)	(0.107)	(0.107)
Separated/Divorced	-0.156**	-0.153**	-0.153**
	(0.064)	(0.068)	(0.068)
Married	-0.132***	-0.149***	-0.149***
	(0.044)	(0.046)	(0.046)
Single	Reference Group	Reference Group	Reference Group
Kids	0.008	-0.012	-0.012
	(0.037)	(0.040)	(0.040)
Weight			
Under weight	0.160	0.052	0.052
	(0.101)	(0.112)	(0.112)
Normal weight	0.141**	0.102	0.102
	(0.064)	(0.067)	(0.067)
Overweight	0.126**	0.106	0.106
	(0.063)	(0.066)	(0.066)
Obese	Reference Group	Reference Group	Reference Group

Health behaviours	Estimates with *June 2005* as exclusion restriction	Estimates with *Mean-LTPA* as exclusion restriction	Estimates with *June 2005* and *Mean-LTPA* as exclusion restriction
Weight Control	0.414***	0.400***	0.400***
	(0.041)	(0.040)	(0.040)
Intensity physical activity at work			
Poor	-0.048	-0.048	-0.048
	(0.053)	(0.057)	(0.057)
Moderate	-0.046	-0.051	-0.051
	(0.044)	(0.047)	(0.047)
Heavy	Reference Group	Reference Group	Reference Group
Intensity physical activity during housework			
Poor	-0.083	-0.107*	-0.107*
	(0.060)	(0.063)	(0.063)
Moderate	-0.010	-0.035	-0.035
	(0.052)	(0.055)	(0.055)
Heavy	Reference Group	Reference Group	Reference Group
Self-assessed family income			
Excellent	0.294**	0.325**	0.325**
	(0.125)	(0.136)	(0.136)
Fair	0.151	0.182*	0.182*
	(0.095)	(0.103)	(0.103)
Insufficient	0.132	0.150	0.151
	(0.097)	(0.106)	(0.106)
Absolutely insufficient	Reference Group	Reference Group	Reference Group
Tenure status of the dwelling			
Rent	-0.049	-0.057	-0.057
	(0.063)	(0.067)	(0.067)
Estate	-0.042	-0.046	-0.046
	(0.071)	(0.076)	(0.076)
Usufruct	-0.068	0.000	0.000
	(0.151)	(0.160)	(0.160)
Other	Reference Group	Reference Group	Reference Group
Villa	-0.111***	-0.122***	-0.122***
	(0.042)	(0.046)	(0.046)
Socio-professional status			
Unemployed	0.111*	0.127*	0.127*
	(0.063)	(0.068)	(0.068)
Self-worker	-0.177**	-0.146	-0.146
	(0.082)	(0.089)	(0.089)
Manager/professional	-0.062	-0.030	-0.030
	(0.101)	(0.110)	(0.110)
Skilled non-manual	-0.122	-0.126	-0.127
	(0.084)	(0.091)	(0.091)
Manual	-0.220***	-0.211**	-0.211**
	(0.081)	(0.087)	(0.087)
Other jobs	Reference Group	Reference Group	Reference Group

Health behaviours	Estimates with *June 2005* as exclusion restriction	Estimates with *Mean-LTPA* as exclusion restriction	Estimates with *June 2005* and *Mean-LTPA* as exclusion restriction
Sector of activity			
Agriculture, hunting, fishing	0.115	0.097	0.097
	(0.073)	(0.078)	(0.078)
Mining, energy	-0.098	-0.037	-0.037
	(0.203)	(0.215)	(0.215)
Industry and manufacturing activities	-0.043	-0.012	-0.012
	(0.057)	(0.062)	(0.062)
Construction	-0.083	-0.115	-0.115
	(0.081)	(0.088)	(0.088)
Trade	-0.021	-0.009	-0.009
	(0.057)	(0.062)	(0.062)
Hotels and restaurants	0.000	0.022	0.022
	(0.088)	(0.095)	(0.095)
Transport, storage and communications	-0.028	0.065	0.065
	(0.088)	(0.093)	(0.093)
Monetary and financial intermediation	0.116	0.045	0.045
	(0.106)	(0.120)	(0.120)
Real estate, renting, computer science, research and other professional or business activities	-0.013	-0.008	-0.008
	(0.094)	(0.104)	(0.104)
Public administration and defence	-0.062	-0.010	-0.010
	(0.066)	(0.072)	(0.072)
Education	-0.088	-0.051	-0.051
	(0.070)	(0.075)	(0.075)
Health and other social services	-0.100	-0.058	-0.058
	(0.069)	(0.074)	(0.074)
Others	Reference Group	Reference Group	Reference Group
Working hours	-0.009**	-0.007	-0.007
	(0.004)	(0.005)	(0.005)
Working hours squared	0.000**	0.000	0.000
	(0.000)	(0.000)	(0.000)
Area of birth			
Piemonte	-0.545	-0.704*	-0.703
	(0.361)	(0.370)	(0.370)
Valle Aosta	-5.336***	-4.394***	-4.394***
	(0.397)	(0.341)	(0.341)
Lombardia	-0.081	-0.254	-0.254
	(0.323)	(0.323)	(0.323)
Trentino Alto-Adige	Reference Group	Reference Group	Reference Group
Bolzano	0.042	-0.188	-0.188
	(0.431)	(0.475)	(0.475)
Trento	-0.288	-0.440	-0.440
	(0.665)	(0.662)	(0.663)
Veneto	-0.209	-0.419	-0.419
	(0.345)	(0.349)	(0.349)
Friuli Venezia Giulia	0.237	0.389	0.389

Health behaviours	Estimates with *June 2005* as exclusion restriction	Estimates with *Mean-LTPA* as exclusion restriction	Estimates with *June 2005* and *Mean-LTPA* as exclusion restriction
	(0.296)	(0.292)	(0.292)
Liguria	-0.297	-0.231	-0.231
	(0.296)	(0.301)	(0.301)
Emilia Romagna	-0.047	0.069	0.069
	(0.253)	(0.259)	(0.259)
Toscana	-0.239	-0.151	-0.152
	(0.262)	(0.274)	(0.274)
Umbria	-0.679	-0.523	-0.523
	(0.480)	(0.494)	(0.494)
Marche	0.114	0.168	0.168
	(0.323)	(0.331)	(0.331)
Lazio	0.323**	0.321**	0.321**
	(0.134)	(0.141)	(0.141)
Abruzzo	0.400**	0.335	0.335
	(0.201)	(0.222)	(0.222)
Molise	-4.885***	-4.478***	-4.479***
	(0.187)	(0.210)	(0.209)
Campania	0.028	-0.014	-0.014
	(0.107)	(0.118)	(0.118)
Puglia	-0.108	-0.154	-0.154
	(0.121)	(0.141)	(0.141)
Basilicata	0.282	0.378*	0.378*
	(0.195)	(0.198)	(0.198)
Calabria	-0.137	-0.097	-0.097
	(0.135)	(0.142)	(0.142)
Sicilia	0.008	0.137	0.137
	(0.123)	(0.124)	(0.124)
Sardegna	0.245	0.254	0.255
	(0.183)	(0.209)	(0.209)
Geographical distribution and size of municipalities where the individuals live			
North-western Italy	-0.089	-0.131**	-0.131**
	(0.058)	(0.066)	(0.066)
North-eastern Italy	-0.079	-0.119*	-0.120*
	(0.059)	(0.066)	(0.066)
Central Italy	-0.023	-0.067	-0.067
	(0.058)	(0.066)	(0.066)
Southern Italy	0.000	-0.052	-0.052
	(0.056)	(0.062)	(0.062)
Islands	Reference group	Reference group	Reference group
Municipalities near the metropolitan area	0.104*	0.095	0.095
	(0.058)	(0.067)	(0.067)
Municipalities at the periphery of metropolitan area	0.018	-0.001	-0.001
	(0.064)	(0.088)	(0.088)
Municipalities with up to 2,000	-0.099	-0.119	-0.119

Health behaviours	Estimates with *June 2005* as exclusion restriction	Estimates with *Mean-LTPA* as exclusion restriction	Estimates with *June 2005* and *Mean-LTPA* as exclusion restriction
inhabitants	(0.067)	(0.084)	(0.084)
Municipalities with 2,001-10,000 inhabitants	-0.088*	-0.102**	-0.102**
	(0.048)	(0.050)	(0.050)
Municipalities with 10,001-50,000 inhabitants	-0.047	-0.058	-0.058
	(0.049)	(0.051)	(0.051)
Municipalities with over 50,000 inhabitants	Reference Group	Reference Group	Reference Group
Activity limitations and disability			
Limitations	0.329***	0.383***	0.383***
	(0.053)	(0.056)	(0.056)
Disability	-0.073	-0.144	-0.144
	(0.219)	(0.228)	(0.228)
Accidents	-0.106	-0.123	-0.123
	(0.089)	(0.095)	(0.095)
Use of rehabilitation services	-0.151*	-0.158*	-0.158*
	(0.083)	(0.089)	(0.089)
Blindness	-0.200	-0.089	-0.089
	(0.545)	(0.570)	(0.570)
Deafness	0.194	0.369	0.370
	(0.400)	(0.411)	(0.411)
Motor disability	-0.015	-0.064	-0.064
	(0.133)	(0.144)	(0.144)
Mental deficiency	0.115	0.104	0.104
	(0.370)	(0.433)	(0.433)
Mental illness	0.349	0.427	0.427
	(0.502)	(0.512)	(0.512)
Health and chronic conditions			
Index of the physical state	-0.008***	-0.007***	-0.007***
	(0.002)	(0.003)	(0.003)
Index of mental state	-0.006***	-0.006***	-0.006***
	(0.002)	(0.002)	(0.002)
Asthma	-0.021	0.003	0.002
	(0.072)	(0.077)	(0.077)
Allergies	0.153***	0.158***	0.158***
	(0.043)	(0.047)	(0.047)
Diabetes	1.218***	1.232***	1.232
	(0.081)	(0.087)	(0.087)
Emphysema	-0.009	-0.009	-0.009
	(0.098)	(0.105)	(0.105)
Hypertension	0.443***	0.432***	0.432***
	(0.048)	(0.052)	(0.052)
Heart attack	0.465***	0.473***	0.473***
	(0.165)	(0.181)	(0.181)
Other heart disease	0.141	0.137	0.137
	(0.102)	(0.111)	(0.111)

Health behaviours	Estimates with *June 2005* as exclusion restriction	Estimates with *Mean-LTPA* as exclusion restriction	Estimates with *June 2005* and *Mean-LTPA* as exclusion restriction
Angina	0.348	0.318	0.318
	(0.213)	(0.242)	(0.242)
Stroke	0.573**	0.407	0.407
	(0.254)	(0.288)	(0.288)
Osteoporosis	0.023	-0.006	-0.006
	(0.092)	(0.100)	(0.100)
Cancer	0.129	0.102	0.102
	(0.112)	(0.124)	(0.124)
Migraine	-0.004	-0.026	-0.026
	(0.046)	(0.050)	(0.050)
Depression	0.117**	0.077	0.077
	(0.059)	(0.065)	(0.065)
Endocrine disease	0.052	0.071	0.071
	(0.064)	(0.067)	(0.067)
Skin disease	0.291**	0.268**	0.268**
	(0.121)	(0.131)	(0.131)
Other chronic diseases	0.294***	0.291***	0.291***
	(0.061)	(0.065)	(0.065)
No opinion	Reference Group	Reference Group	Reference Group
Cons	-1.667***	-1.634***	-1.635***
	(0.332)	(0.370)	(0.370)
N	16446	14316	14316
Log-likelihood	-9413.2094	--7857.37	-7851.557
Wald stat.	10395.30***	7051.13***	7082.72
AIC	19252.42	16140.74	16131.11
BIC	20894.19	17752.97	17750.91
Degree of freedom	213	213	214

Notes: significance levels: * $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.01$.

Table 3.9. Exogeneity test - $H_0: \rho = 0$, recursive probit models - healthy diet.

Healthy behaviours	Estimates with *June 2005* as exclusion restriction			Estimates with *Mean-LTPA* as exclusion restriction			Estimates with *June 2005* and *Mean-LTPA* as exclusion restriction		
	$\hat{\rho}$	Test Z	*rho* Wald test	$\hat{\rho}$	Test Z	*rho* Wald test	$\hat{\rho}$	Test Z	*rho* Wald test
Healthy diet	-.19*	-1.77	2.69*	-.14**	-2.07	4.28**	-.15*	-1.80	3.22*

Notes: significance levels: * $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.01$.

4 CONCLUSIONS

In recent years, there has been a marked increase in the use of complementary and alternative medicine in the developed Countries. However, to maximize the potential of alternative therapies as an effective and useful source of health care, some relevant issues still need to be tackled.

This topic was systematically reviewed in the thesis, based on the determinants of Complementary and Alternative Medicine (CAM) use. In particular, the thesis highlighted that promoting the safety, efficacy and quality standards of alternative treatments is a priority to preserve the health of citizens and, at the same time, to avoid any waste of economic resources. Ensuring the access to mainstream medicine for poor individuals is also relevant to avoid that the alternative medicine is used as a substitute of traditional therapies; this is even more important for diseases that require strong and well-known treatments. Moreover, the review also outlined that moral hazard, related to the potential increase in the use of unnecessary CAM therapies covered by the National Health System, is a relevant economic issue not adequately discussed by the existing literature.

The thesis was aimed to investigate a relevant health economic issue, not examined in the literature: the causal effect of some important healthy behaviours on CAM use. The analysis was carried out for both the Italian and English populations and some important results were outlined.

The comparison between two econometric models showed that individual unobservable heterogeneity strongly affects the estimates and that recursive equations are necessary to obtain unbiased results. A physically active lifestyle significantly influences the CAM use: alternative treatments might be considered part of primary prevention, which includes both the health lifestyle decisions and all the other activities that reduce the occurrence or the incidence of diseases. Furthermore, the other determinants of CAM use - female gender, middle aged, high level of education, some pains, chronic diseases and physical limits –

globally suggest that alternative care could be also included among tertiary prevention, a category that includes the actions that reduce disability associated with a chronic health conditions.

The existence of a causal effect of leisure-time physical activity on non-smoking habit and healthy diet was investigated, taking into account the econometric challenge caused by the presence of unobservable individual heterogeneity.
The results pointed out a strong, positive effect of Leisure Time Physical Activity (LTPA) on other two important lifestyles: non-smoking and healthy eating. Therefore, important and useful considerations can be outlined. Particularly, effective and well organized health promotion programs may lead to substantial savings, whether a support regular LTPA is encouraged for general population. In fact, a reduction of the healthcare costs related to smoking and unhealthy diets can be presumably expected.

The limitations of this thesis are mostly related to the characteristics of the data; most of them are self-reported and, as reported by the literature, people usually under-report negative health behaviours; as a consequence, the relationships among CAM use, non-smokers, healthy diet and alcohol consumption may be underestimated.
The second limitation is about the goodness of the exclusion restrictions used to identify the models, in particular for the third chapter. The instruments should capture the part of the variance of the endogenous variables not correlated with the error term, which includes all the unobservable factors. Considering that the lifestyles are presumably influenced by unobserved variables such as time preferences and risk aversion, it is essential that the exclusion restrictions are not related to individual time preferences.
However, the several statistical-tests carried out, and also the findings shown by the experimental trials, globally suggest that the estimates are unbiased and valid.

This study also indicates the issues to be further investigated.
A "difference and difference estimator" or a "matching estimator" may be implemented to obtain unbiased estimates about the potential distortions in the demand for CAM caused by the moral hazard issue. The estimate results may be used to guide both theory and public

policy.

In addition, the relation between CAM use and educational level may be better investigated trying to consider the endogeneity issue. In fact, the link between schooling and preventive decisions is presumably affected by a "hidden third variable", i.e. the rates of time preference. In particular, investments in both schooling and prevention are more likely for individuals with low rates of time preferences (Fuchs, 1982; Farrell and Fuchs, 1982). On the other hand, differences in health could cause differences in time preferences: better health increases future utility levels (Beker and Mulligan, 1997). The difficulty empirically to explore the relation between CAM and education is great but the findings could be useful to know more about the consumer demand for prevention.

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