Is car use related with successful ageing of older adults? Results from the multi-national MEDIS study

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Abstract

Purpose: The aim of the present work was to evaluate the relation between car use and the level of successful ageing of a random sample of older adults living in the Mediterranean basin. **Methods:** During 2005-2011, 2749 older (aged 65-100 years) from 22 Mediterranean islands and the rural Mani region (Peloponnesus) of Greece were voluntarily enrolled in the MEDIS cross-sectional study. Socio-demographics, medical conditions, dietary and lifestyle habits, were derived throughout standard procedures. Car use was recorded with a standard binary question. A successful ageing index ranging from 0 to 10 was used. **Results:** Older adults that used a car on regular basis had significantly higher levels of successful ageing, as well as less prevalence of obesity and hypertension while were more physically active (p<0.001). After adjusting for several confounders car use was still positively related with elderly islander´s successful ageing level [beta-coefficient (95% CI): 0.65 (0.54 to 0.77)]. **Conclusions:** In conclusion, the activity of car use seems to be an indicator of quality of life among older adults, as measured through successful ageing.

Keywords: Successful ageing; car use; driving; Mediterranean islands; older adults

Introduction

The principals of healthy and successful ageing remain among the major challenges of public health [1]. The early detection of the population's level of successful ageing will help the authorities to put forward policies for the elders. Past and recent studies have reported a variety of successful ageing determinants [1, 2]. Among them are socio-demographic factors, various co-morbidities, dietary and lifestyle habits, psychosocial factors, body composition changes and others [1, 2]. In relation to that the ageing

process is quite complex and is associated with a variety of factors, not only with physical health.

In general successful ageing determinants remain not well understood and appreciated. In relation to that, a pair of studies has been reported that the car use is associated with successful ageing [3, 4]. Strawbridge and colleagues [4] reported that higher proportion of the US successful agers are engaging with car driving, while Andrews et al. has reported that no driving is related with intermediate and lower functioning status [3], in Australian older individuals. It should be taken into account that car use is based as well on the social, cultural, and environmental contexts. Driving behaviors among older adults tend to be influenced by transportation options (i.e., accessibility to public transportation, neighborhood characteristics and transportation use patters) [5]. Islands like Cyprus republic, Crete, Mallorca, Menorca, etc are having a much more advanced public transportation system in comparison with other insular areas of the MEDIS study (i.e., Kassos, Lemnos, Thasos etc). In relation to the aforementioned, driving is a complex activity that is related with mental and cognitive health (in older adults the neuro-ergonomy of the individuals is declining along with visual and hearing abilities and the coexistence of co-morbidities [6]), social interaction as well as with engagement in social activities which are basic components of the successful ageing concept [7]. However until now, the interrelated pathway of car use and driving activity in the level of successful ageing has never been explored in the past for Mediterranean/European populations.

Given the complexity of the successful ageing pathway, together with the lack of data regarding driving activity/car use among older adult populations, the aim of the present work was to evaluate the car use (i.e., driving), in the successful ageing of a random sample of older adults living in the Mediterranean basin.

Methods
The MEDIS study sample
During 2005-2011, a population-based, multi-national, convenience and cross-sectional sampling was performed to voluntarily enroll older people from 22 Mediterranean islands: Republic of Cyprus (n=300), Malta (n=250), Sardinia (n=60), Sicily (n=50), Mallorca and Menorca (n=111) and the Greek islands of Lesvos (n=142), Samothrace (n=100), Cephalonia (n=115), Crete (n=131), Corfu (n=149), Limnos (n=150), Ikaria (n=76), Syros (n=151), Naxos (n=145), Zakynthos (n=103), Salamina (n=147), Kassos (n=52), Rhodes and Karpathos (n=149), Tinos (n=129), as well as Gokceada in Turkey (n=55), and from the rural region of Mani (n=153) (a southern Greek peninsula). A group of health scientists (physicians, dietitians and nurses) with experience in field investigation collected all the required information using a quantitative questionnaire and standard procedures.

Further details about the MEDIS study protocol may be found elsewhere [1].
Bioethics
The study followed the ethical considerations provided by the World Medical Association (52nd WMA General Assembly, Edinburgh, Scotland, October 2000). The Institutional Ethics Board of Harokopio University approved the design and procedures of the study (reference No. 16/19-12-2006). Participants were informed about the aims and procedures of the study and gave their consent prior to being interviewed.
Evaluation of clinical, anthropometric, socio-demographic, dietary habits and other lifestyle characteristics of the participants

All the measurements taken in the different study centres were standardized and the questionnaires were translated in all the cohorts' languages following the World Health Organization (WHO) translation guidelines for tools assessment. Weight, height, waist circumference, body mass index (BMI), diabetes mellitus, blood pressure, fasting blood lipid levels were measured using a standard protocol [1].

Basic socio-demographic characteristics, such as age, gender, years of school, financial status and lifestyle characteristics, such as smoking habits and physical activity status, were recorded. Regarding financial status, the participants were asked to report their mean income during the previous three years using a four-point scale (low, inadequate to cover daily expenses = 1, medium, trying hard to cover daily expenses = 2, good, adequate to cover daily expenses = 3, very good, very adequate to cover daily expenses = 4); this scale was decided upon because of the variety of the populations studied, as well as the common difficulty of accessing exact financial data. Car use was evaluated using a standard question, i.e., "are you driving a car for your daily needs? (never, sometimes a week, often, always)", but it was combined to a binary (yes / no) due to the small number of cases in the intermediate classes.

Physical activity was evaluated in MET-minutes per week, using the shortened, translated in all the cohort's languages and validated in Greek version of the self-reported International Physical Activity Questionnaire (IPAQ)[8]. As minimally active or "health-enhancing physical activity (HEPA) active" were classified individuals who reported at least 3 MET-minutes per week. Furthermore, the weekly frequency of physical activity was recorded. Dietary habits were assessed through a semi-quantitative, validated and reproducible food-frequency questionnaire. To evaluate the level of adherence to the Mediterranean diet, the MedDietScore (theoretical range 0-55) was used [9]. Higher values for this diet score indicate greater adherence to the Mediterranean diet. Furthermore, consumption of various alcoholic beverages was measured in terms of wineglasses per day, adjusted for ethanol intake (i.e. one 100 ml glass of wine was considered to have 12% ethanol) and classified for the present analyses, into 0 for no alcohol consumption and 1 for alcohol consumption of at least 1 glass/week. A similar dichotomized coding followed for the tea and coffee consumption.

Current smokers were defined as smokers at the time of the interview. Moreover, in order to evaluate the older adult's social participation, the weekly frequency of their social activities with their family, their friends as well as their yearly frequency of excursions were recorded.

Evaluated outcomes

There are different definitions for successful ageing [10, 11]. Following the multi-dimensional approach of successful ageing reported by other experts[12] and the MEDIS study group [1], 10 components (i.e., education as measured in years if school, financial status, physical activity status as classified using the IPAQ, body mass index, psychological level as measured using the GDS score, participation in social activities with friends, with family, yearly excursions, burden of CVD risk factors and dietary habits as evaluated using the MedDietScore) were incorporated for the measurement of successful ageing [1].

Individual ratings (from 0 to 1) in each of the 10 components were assigned, according to their positive or negative (i.e., reverse scoring) influence on successful ageing, according to the current literature [1]. Specifically, for 3-scale components [normal weight/overweight/underweight or obese, no/mild/severe depression (GDS

score), low/moderate/high adherence to the Mediterranean diet (MedDietScore)], the value of 0.5 was used in order to code the intermediate level (i.e., overweight, mild depression, moderate adherence to the Mediterranean diet). Similarly, for the 4-scale components (i.e., 0-2 years/3-6 years/7-12 years/> 13 years of education, none/1-2 times/3-5 times/>5 times weekly physical activity, and low/moderate/good/very good financial status), the score 0 was used if the individual was in the lowest level, scores 0.33, 0.66 and 1 were given for each higher level. Additionally, for the 5-scale components (i.e., none/1 time/2 times/3-5 times/> 5 times of weekly social activities with friends, and with family, none/1 time/2 times/3-5 times/> 5 times of yearly excursions, none/1 factor/2 factors/3 factors/4 factors of CVD risk), a response level was coded using the additional values of 0, 0.25, 0.5, 0.75 and 1 if the person ranged from the lowest level to the highest, respectively. The score was reversed for the CVD risk score, the BMI levels and the GDS score.

The composed successful ageing index was represented as the cumulative score of the 10 components (theoretical range 0-10). Higher scores corresponded to higher levels of successful ageing [1].

Statistical analysis

Continuous variables are presented as mean ± standard deviation (SD) and categorical variables as frequencies. Comparisons of continuous variables between groups of study were performed using the independent samples t-test and the Analysis of Variance (for the normally distributed variables), or the Mann-Whitney U-test and the Kruskall-Wallis test (for the skewed variables). Associations between categorical variables were evaluated using the chi-square test. Linear regression models were applied in order to evaluate the association between various socio-demographic, bio-clinical, nutritional factors (independent variables), the car use and the level of successful ageing (dependent outcome). Colinearity was tested using the Variance Inflation Factor criterion (VIF; values >4 suggest colinearity). The assumption of homoscedasity was tested by plotting the scatter plot of standardised residuals over the predicted score values. Results from linear regression models are presented as beta-coefficients and their 95% Confidence Intervals. All reported p-values were based on two-sided tests. The level of statistical significance was set at $P<0.05$. SPSS software (version 20) was used for all calculations (IBM Statistics, Greece).

Results

In the entire MEDIS sample, the percentage of older adults regularly using a car was 54%. Demographic, behavioral, clinical, anthropometric and lifestyle characteristics of the sample, by car use, are summarized in *Table 1*. Compared with those not using a car, the car users were younger (p<0.001), of male gender (p<0.001), were less obese (p=0.004), were more physically active (p<0.001), more actual smokers (p<0.001), more educated and had high financial status (p<0.001), were consuming more alcohol (p<0.001), had lower prevalence of hypertension (p<0.001), had higher successful ageing rates (p<0.001), while the most of them weren't living alone (p<0.001).

[Table 1]

In *Table 2* factors associated with the level of successful ageing among older Mediterranean, are presented. Specifically, a consistent relationship between the car use and the level of successful ageing was reported (*model 1 to model 3*). After adjusting for several confounders, like age, sex, urban residence (*model 1*), smoking habits, alcohol, coffee, and tea intake (*model 2*), and living alone (*model 3*), data analysis confirmed that the car use was positively related with elderly islander's successful ageing level

[beta-coefficient (95% CI): 0.65 (0.54 to 0.77)].
[Table 2]

      When the analysis was stratified by gender, in males, car use was associated with successful ageing levels at grater rates [beta-coefficient (95% CI): 0.49 (0.33 to 0.67)] than was in females [beta-coefficient (95% CI): 0.77 (0.61 to 0.93)]. Moreover when stratified analysis applied by age group (65-80 and 81[+] years old) car use was similarly related with the successful ageing status [65-80 years old: beta-coefficient

Table 1. Demographic, behavioral and lifestyle characteristics of the Multi-national MEDIS sample, by car owing/driving categorization

	Car driving (n=1329)	No Car driving (n=1146)	P
Age (years)	72±6	76±8	<0.001
Sex (male %)	60	37	<0.001
Urban residence (%)	57	59	0.31
Obesity (%)	29	35	0.004
Education (years of school)	8.0±4.2	5.5±3.2	<0.001
High financial status (%)	23	12	<0.001
Living alone (%)	13	39	<0.001
Current smoking (%)	20	10	<0.001
Physical activity (%)	45	36	<0.001
MedDietScore (0-55)	32.9±4.7	32.5±4.8	0.06
Alcohol consumption (%)	56	42	<0.001
Coffee consumption (%)	84	81	0.11
Tea consumption (%)	42	44	0.31
Hypertension (%)	57	68	<0.001
Diabetes Mellitus (%)	22	23	0.83
Hypercholesterolemia (%)	48	50	0.22
Successful ageing (0-10)	3.0±1.3	2.1±1.2	<0.001

(95% CI): 0.69 (0.57 to 0.83); 81[+]years old: beta-coefficient (95% CI): 0.61 (0.36 to 0.85)] (data shown only in text).

Table 2. Results from additive multiple linear regression models performed to evaluate the association of various bio-clinical, lifestyle characteristics and car owing/driving of the MEDIS study participants in relation to successful ageing level (*n*=2100).

	Model 1		Model 2		Model 3	
	beta-coefficient	95%CI	beta-coefficient	95%CI	beta-coefficient	95%CI
Car driving (Y/N)	0.62	0.51, 0.74	0.62	0.51, 0.74	0.65	0.54, 0.77
Age (per 1 year)	-0.004	-0.01, 0.004	-0.002	-0.01, 0.006	-0.001	-0.01, 0.007
Sex (men vs. women)	0.45	0.34, 0.55	0.26	0.14, 0.38	0.25	0.13, 0.37
Urban residence (Y/N)	0.01	-0.10, 0.11	-0.04	-0.15, 0.06	-0.07	-0.18, 0.04
Current smoking habits (Y/N)	-	-	0.13	-0.02, 0.28	0.17	0.02, 0.33
Alcohol intake (Y/N)	-	-	0.51	0.39, 0.61	0.49	0.37, 0.60
Coffee intake (Y/N)	-	-	-0.27	-0.44, -0.09	-0.26	-0.45, -0.08
Tea intake (Y/N)	-	-	-0.38	-0.15, 0.08	-0.06	-0.18, 0.06
Living alone (Y/N)	-	-	-	-	-0.06	-0.19, 0.08

Discussion

The present work revealed a consistent association between car use and successful ageing; particularly, multi-adjusted analysis revealed that car use was positively related with the levels of successful ageing, irrespective of the age, gender, urban or rural residence, and other potential confounders. Despite the plausible limitation of a vice – versa relationship, the aforementioned relationship, has rarely been studied among older adults in Europe and globally [3,4]; and therefore deserves further attention. In particular car use may be considered as a determinant, a functioning indicator of successful ageing instead of more complicated tools.

Due to the dramatic changes in global population demography and the growing number of older adults, there is an increasing interest in successful and healthy ageing. Until now the determinants of successful ageing remain not well understood and appreciated [1]. Despite the lack of previous findings regarding the role of leisure activities (such as the car use) on the ageing process among Mediterranean populations, a limited number of studies have previously reported that car driving is related with successful ageing of older individuals. Stawbridge and colleagues have reported that driving a car is an activity mostly reported by successful agers over 75 years old living in a US county [3]. According to the researchers, the successful agers had reported more participation in other leisure activities and had better physical and mental health. The aforementioned are in accordance with our analysis were it was reported that those older adults that are using a car, are having lower prevalence of hypertension and obesity and are more physically active in comparison with those that are not using a car. Also car drivers are having a higher successful ageing status for 1 unit in comparison with non car-drivers. If this is transformed in a percentage scale it reflects that car drivers are having 10% better successful ageing status than the non-car drivers. This difference is the highest among previous publications of the same successful ageing score [1, 13, 14].

6

It has been suggested that the ageing process reflects interrelations among multi-dimensional domains such as the physical health, functional limitations, social participation and engagement [1, 13-15]. Healthy and successful ageing concept has been associated with better health outcomes [1]. The analysis of the MEDIS data revealed that car use was positively related on the levels of successful ageing. This positive association remained consistent after the inclusion of various confounders (*model 1* to *model 3*). Until now, the information about car use among older adults and its interrelation with the level of successful ageing is sparse. As a part of that, it has been reported in the literature that, neuro-ergonomics decline is highly related with the ageing process. Specifically advanced age is associated with lower visual acuity, reduction in visual field of view, contrast sensitivity, less divided attention capacity in different environments, lower brain activity, etc [6]. Also aging is accompanied with increased co-morbidities diabetes, cardiovascular disease, cognitive impairments, Alzheimer's disease, etc that could affect driving activity in the older age [6]. In addition to the aforementioned, well documented studies in older individuals have been reported that car driving/use, as an activity, is related with better mental health and cognitive performance as well as with higher functional status [5]. Driving ability is interrelated with individual's physical health and functional status [3]. Moreover according to other researchers, driving cessation in the elders is an indicator of lower social interactions as well as with lower engagement in social activities and participation in the community [5]. Successful ageing is considered as low probability of disease and disability, high cognitive and physical capacity, and active participation through social activities [1]. All of the aforementioned support the proposed pathway between successful ageing and the car use. However, further studies, with longitudinal data, are needed to confirm and expand our results.

Strengths and Limitations

The present study has several strengths. It is first that evaluated the effect of car use in the successful ageing of older people living in the Mediterranean basin. A main limitation is that reverse relationships may exist and successfully aged may be the ones that therefore can still use a car. Another limitation is that the analysis wasn't adjusted for other transportation and built environment options since weren't measured in the MEDIS study. Also, the successful ageing index that was used may not accurately estimate the successful ageing status. This methodology, however, was based on a standard procedure described in the literature [16].

Conclusion

Doubtless, it is of major interest to study the characteristics of successful agers and moreover, to understand the dynamics and the transforming nature of ageing. Data analysis of the study revealed that daily activities, like the car use/driving in the older population are related with successful ageing status. Thus, actions should be made towards these directions (i.e., transportation and built environment enhancement) in order to promote self-mobility by all means in aging populations [17].

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Authorship

ST and DP: concept and design of the study, acquisition of data, analysis and interpretation of data, preparation of manuscript. MM, AM, SP, GV, VB, FA, AZ, DT, AF, EG, GM: acquisition of data, interpretation of data, review of manuscript. EP, AM, GS, JAT, AM, CL, LSD: critical review and revision of manuscript for important intellectual content.

Conflict of Interest

Conflicts of interest: none

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