PEER REVIEW HISTORY

ARTICLE DETAILS

TITLE (PROVISIONAL)	Social participation and the combination of future needs for long-term care and mortality among older Japanese people: A prospective cohort study from the Aichi Gerontological Evaluation Study (AGES)
AUTHORS	Takahashi, Sei; Ojima, Toshiyuki; Kondo, Katsunori; Shimizu, Sayaka; Fukuhara, Shunichi; Yamamoto, Yosuke

VERSION 1 – REVIEW

REVIEWER	Kari Nilsen Assistant Professor, Family Medicine Director of Research University of Kansas School of Medicine- Wichita Wichita KS 67214 United States of America
REVIEW RETURNED	03-May-2019

GENERAL COMMENTS	This article is very well written and addresses an important topic- social participation and its affect on aging. The large sample size is definitely a plus, as well as the 9.4 year follow up. It is encouraging that staying socially engaged as you age has such a positive effect on older adults. One point that I would like the authors to address. Please use "participants" throughout instead of "subjects". The people in the study elected to participate.

REVIEWER	Marijke Veenstra NOVA, Oslo Metropolitan University
REVIEW RETURNED	09-May-2019

GENERAL COMMENTS	Summary This study uses a large-scale prospective cohort study (AGES) including 9,741 Japanese aged 65 years and older from 6 municipalities. They participated in a survey at baseline in 2003 and were linked with data from the municipal registers to up to 9,4 years later. Only persons without ADL needs and without registered long-term care services at baseline were included in the survey. More information on AGES is given in a publication from 2003 (Nishi et al.), which also describes moderate response rates. The data are not obtained from a national representative sample. The main outcome in the present study is incidence of disability or death at the end of 9.4 year observational period. (Current) Social participation was measured with the JGSS and includes 8 domains. In the main analyses of the current paper the authors reduce this information to a dummy variable 0 ‘No participation in any group’ 1 ‘Participation in

	1 group or more'. They do however, also conduct secondary analyses on the different domains of social participation. Multinomial logistic regression analyses (Survival without disability, Survival with disability and Death) were used to assess the effect of social participation, adjusted for a wide range of possible confounders. Findings indicate support for a long-term effect of social participation on disability and death, social participation in 2003 is associated with lower risks for disability and death 9.4 years later. More specifically, this concerns three domains of social participation: local community, hobby groups and sports group or clubs. Interestingly, participation in religious organizations is associated with a higher risk for disability. The paper is well structured and the research questions and analyses are clearly specified. A major limitation, as the authors also indicate themselves, is that social participation is only measured at baseline and used as a rather crude measure. Information on intensity or duration of social participation is not available. All in all a very topical and interesting paper. I do have, however, some major comments. 1. Page 4: The World Health Organization has proposed ….. in order to decrease the social burden of vulnerable older people. I think it is very unfortunate (and also wrong) to indicate that healthy ageing is formulated in order to decrease the social burden of older vulnerable people. The aim of the WHO is not to reduce the number of older people who need care. The aim is to maintain functioning and wellbeing. Although the sustainability of the welfare state is of course an issue in trying to maintain as healthy and independently functioning as long as possible, and postpone reliance on long-term care, the main issue in healthy ageing is not to avoid long term care altogether. As a matter of act, the WHO underlines the important role that long term care, and the health system in general, play in contributing to social participation and the empowerment of people. Hence, these parts of the introduction need to be rephrased. 2. I also miss some of the major literature documenting the link between social capital, social participation and health/survival. This is a major field and although Putnam wrote a seminal book on this topic, there are some major publications within the fields of gerontology and epidemiology that are relevant for this paper and have a stronger focus on health promotion, f.ex Berkman 1995- the role of social relations in health promotion. Actually, the health effects of social capital, social networks and social participation are quite well known for some time now. Social participation is considered a key determinant of successful and healthy aging. But there is no agreement on its definition and underlying dimensions. It would be an improvement if the authors could show more clearly that they build on this existing literature and research. 3. The authors use functional disability as one of their main outcomes. However, this is operationalised as certification of the need for long term care, which is the result of a formal evaluation based on a home-visit in the municipality and derived from the database provided by the municipalities. I would not define this as disability but need for long-term care. There are important differences as care assessments also are affected by an initiated demand for services. Although this is probably mostly based on health needs (ADL), health care demands and behaviour are also affected by other factors, related to the individual (e.g. personality), family circumstances as well as local context. I would not use the concept of disability here, but rather call it what it is: need for LTC. From what I understand from the design, is that not all subjects in

	the sample have been measured on their health and disability (need for LTC) after 2003, only those who were formally evaluated. Please clarify this in the method section being specific on what triggers such a home visit. This could also be relevant information in relation to the unexpected effect of religious organizations or groups. 4. Statistical analysis: education is (forgotten) not mentioned as confounder but included in the analyses and tables. 5. The authors write “missing data for all variables were not imputed” at page 7, and “all analyses were performed with multiple imputation methods using STATA..”. Contradicting? Please clarify or correct. 6. Results: Only age differences are commented upon in relation to supplementary table 1. The authors could comment upon the differences according to education and income as well. Table S1 does not give any information on the proportion of social participation across the 8 domains. (please correct). Table 2 does. 7. Table 1 – please change the < signs into > for education, walking time and income? Otherwise I have trouble understanding the effects. 8. Table 1 – please clarify the title – multinomial logistic regression – reference category =… No disability. 9. Correct footnote Table 1 – only the effect of social participation is adjusted for these confounders – age effects are also adjusted for social participation etc. Leave out footnote here? 10. Could you also provide p-values or indicate levels of statistical significance? 11. Discussion: Reformulate first sentence – loss of healthy aging? 12. Discussion: I find it difficult to believe that this is the first longitudinal study examining the association between social participation and health/mortality. How about f.ex. Yu, Sessions,Fu & Wall. Soc Sci Med. 2015 A multilevel cross-lagged structural equation analysis for reciprocal relationship between social capital and health? Or: Hsu: Does social participation by the elderly reduce mortality and cognitive impairment? Other studies might have used concepts measuring similar activities, but not called it social participation but f.ex social engagement. 13. Discussion p13: Further studies are needed to reveal… healthy aging. This is a little too easy. Could you be more precise and indicate what and how? What kind of study would you suggest that takes this field further and that accounts for the limitations described? The WHO emphasizes the role of the community (see f.ex. https://www.who.int/social_determinants/thecommission/countrywork/within/socialparticipation/en/). With your system of home visits that would perhaps constitute a feasible way to propel this field forward. The discussion could benefit from tying the findings closer to public health policy and interventions in local (community) settings.

VERSION 1 – AUTHOR RESPONSE

Response to Reviewer 1
This article is very well written and addresses an important topic- social participation and its affect on aging. The large sample size is definitely a plus, as well as the 9.4 year follow up. It is encouraging that staying socially engaged as you age has such a positive effect on older adults.

One point that I would like the authors to address. Please use "participants" throughout instead of "subjects". The people in the study elected to participate.

RESPONSE:
We wish to express our appreciation to the reviewer for their positive and insightful comments.
We changed all mentions of “subjects” to “participants.”

Reviewer: 2
Review manuscriptbmjopen-2019-030500
Social participation and the combination of future disability and mortality among Japanese older people: A prospective cohort study from the Aichi Gerontological Evaluation Study (AGES)
Summary
This study uses a large-scale prospective cohort study (AGES) including 9,741 Japanese aged 65 years and older from 6 municipalities. They participated in a survey at baseline in 2003 and were linked with data from the municipal registers to up to 9,4 years later. Only persons without ADL needs and without registered long-term care services at baseline were included in the survey. More information on AGES is given in a publication from 2003 (Nishi et al.), which also describes moderate response rates. The data are not obtained from a national representative sample. The main outcome in the present study is incidence of disability or death at the end of 9.4 year observational period. (Current) Social participation was measured with the JGSS and includes 8 domains. In the main analyses of the current paper the authors reduce this information to a dummy variable 0 ‘No participation in any group’ 1 ‘Participation in 1 group or more’. They do however, also conduct secondary analyses on the different domains of social participation. Multinomial logistic regression analyses (Survival without disability, Survival with disability and Death) were used to assess the effect of social participation, adjusted for a wide range of possible confounders. Findings indicate support for a long-term effect of social participation on disability and death, social participation in 2003 is associated with lower risks for disability and death 9.4 years later. More specifically, this concerns three domains of social participation: local community, hobby groups and sports group or clubs. Interestingly, participation in religious organizations is associated with a higher risk for disability.

The paper is well structured and the research questions and analyses are clearly specified. A major limitation, as the authors also indicate themselves, is that social participation is only measured at baseline and used as a rather crude measure. Information on intensity or duration of social participation is not available. All in all a very topical and interesting paper. I do have, however, some major comments.

RESPONSE:
Thank you for providing these interesting and significant comments. As you indicated, we did not measure the intensity and duration of social participation. In accordance with your suggestion, we added the limitations as follows: (page 14, para 3)

“We could not use the information regarding the intensity and duration of social participation.”

1. Page 4: The World Health Organization has proposed ….. in order to decrease the social burden of vulnerable older people.
I think it is very unfortunate (and also wrong) to indicate that healthy ageing is formulated in order to decrease the social burden of older vulnerable people. The aim of the WHO is not to reduce the number of older people who need care. The aim is to maintain functioning and wellbeing. Although the sustainability of the welfare state is of course an issue in trying to maintain as healthy and independently functioning as long as possible, and postpone reliance on long-term care, the main issue in healthy ageing is not to avoid long term care altogether. As a matter of act, the WHO underlines the important role that long term care, and the health system in general, play in contributing to social participation and the empowerment of people. Hence, these parts of the introduction need to be rephrased.

RESPONSE:
We understand your concern. In accordance with your suggestion, we have changed the introduction phrases as follows: (page 4, para 1)

"…within the Japanese healthcare system[3]. These populational transitions would have enormous influences on our access to quality health and social care. The World Health Organization has proposed the concept of "Healthy Aging," defined as "the process of developing and maintaining the functional ability that enables well-being in older age,"[4] for all people to live long and healthy lives."

2. I also miss some of the major literature documenting the link between social capital, social participation and health/survival. This is a major field and although Putnam wrote a seminal book on this topic, there are some major publications within the fields of gerontology and epidemiology that are relevant for this paper and have a stronger focus on health promotion, f.ex Berkman 1995- the role of social relations in health promotion. Actually, the health effects of social capital, social networks and social participation are quite well known for some time now. Social participation is considered a key determinant of successful and healthy aging. But there is no agreement on its definition and underlying dimensions. It would be an improvement if the authors could show more clearly that they build on this existing literature and research.

RESPONSE:

Thank you for your comment. We have changed the definition of social participation and rephrased it as follows: (page 4, para 2)

"Social participation has been defined by Putnam[5], Berkman[6] and various researchers. Particularly, it was defined by the WHO as a component of the social determinant of health and it contains various kind of forms as follows: informing people with balanced, objective information; consulting, whereby the affected community provides feedback; involving or working directly with communities; collaborating by partnering with affected communities in each aspect of the decision making process, including the development of alternatives and the identification of solutions; and empowering people by ensuring that communities retain ultimate control over the key decisions that affect their wellbeing.[7]"

3. The authors use functional disability as one of their main outcomes. However, this is operationalised as certification of the need for long term care, which is the result of a formal evaluation based on a home-visit in the municipality and derived from the database provided by the municipalities. I would not define this as disability but need for long-term care. There are important differences as care assessments also are affected by an initiated demand for services. Although this is probably mostly based on health needs (ADL), health care demands and behaviour are also affected by other factors, related to the individual (e.g. personality), family circumstances as well as local context. I would not use the concept of disability here, but rather call it what it is: need for LTC. From what I understand from the design, is that not all subjects in the sample have been measured on their health and disability (need for LTC) after 2003, only those who were formally evaluated. Please clarify this in the method section being specific on what triggers such a home visit. This could also be relevant information in relation to the unexpected effect of religious organizations or groups.

RESPONSE:
Thank you for your comment. We have changed the word "disability" to "need for LTC" and corrected the outcome sentences as follows: (page 7, para 1)

"Outcomes
The primary outcome was the need for LTC or death at the end of the 9.4-year observational period. The need for LTC was determined based on a formal evaluation in accordance with routine criteria that combine a home-visit evaluation with the judgment of the primary doctor.[18] Applicants or their family members essentially apply to their municipality for certification of LTC when the applicants find themselves in need of some care support or users' family members recognize that they need to introduce care support in the user's life.[19]"

4. Statistical analysis: education is (forgotten) not mentioned as confounder but included in the

analyses and tables.

RESPONSE:
Thank you for pointing this out. We have changed the sentence about statistical analysis as follows: (page 7, para 2)

“In the primary analysis, we performed multinomial logistic regression analyses with adjustment for possible confounders (age per five-year increment), gender, living alone, educational attainment (more than nine years), smoking, alcohol consumption, walking time (more than 30 minutes a day), annual household income (more than 3,000,000 yen a year), and number of comorbidities (one or more than two)…”

5. The authors write “missing data for all variables were not imputed” at page 7, and “all analyses were performed with multiple imputation methods using STATA..”. Contradicting? Please clarify or correct.

RESPONSE:
We did not use the multiple imputation method in the article and corrected it as follows: (page 8, para 3)

“All analyses were performed using STATA version 14.2 (Stata Corp., LP, College Station, TX, USA).”

6. Results: Only age differences are commented upon in relation to supplementary table 1. The authors could comment upon the differences according to education and income as well. Table S1 does not give any information on the proportion of social participation across the 8 domains. (please correct). Table 2 does.

RESPONSE:
Thank you for the advice. We have corrected the paper as follows: (page 8, para 5)

“Figure 1 shows the flow diagram of the study. Among 15,313 participants, 9,863 (73.6%) were in the social participation group. The mean age was 72.5 years in participants with social participation and 72.9 years in those without social participation. The highest proportion of social participation was seen in local community and hobby groups. Around 10% of the social participation group participated in political groups, industrial groups, religious groups, and volunteer groups. The proportion of higher educational attainment and higher household income was about 10% higher in the social participation group. Thus, participants with social participation were likely to present higher educational attainment and higher household income than those without (Supplementary Table S1).”

Supplementary Table S1. Baseline characteristics
Social participation Non-participation Total
N (%) 9,863 (73.6) 3,547 (26.5) 13,140
Age, y Average ± Standard deviation 72.5±5.7 72.9±6.3 72.6±5.8
Gender (%) Men 4,902 (49.7) 1,696 (47.8) 6,598 (49.2)
Social participation (%) Local community 7,613 (77.2) - 7,613 (56.8)
Hobby groups 4,045 (41.0) - 4,045 (30.2)
Sports groups or clubs 2,671 (27.1) - 2,671 (19.9)
Political organization or groups 1,029 (10.4) - 1,029 (7.7)
Industrial or trade associations 1,298 (13.2) - 1,298 (9.7)
Religious organizations or groups 1,544 (15.7) - 1,544 (11.5)
Volunteer groups 1,330 (13.5) - 1,330 (9.9)
Citizen or consumer groups 623 (6.3) - 623 (4.7)
Family status Living alone 936 (9.5) 374 (10.5) 1,310 (9.8)
Missing 0 (0.0) 0 (0.0) 0 (0.0)
Educational attainment ≥ 9 years 4,291 (43.5) 1,185 (33.4) 5,476 (40.8)
Missing 77 (0.8) 46 (1.3) 123 (0.9)

Smoking Current smoker 1,190 (12.1) 511 (14.4) 1,701 (12.7)
Missing 291 (3.0) 171 (4.8) 462 (3.5)
Alcohol Current drinker 2,161 (21.9) 638 (18.0) 2,799 (20.9)
Missing 129 (1.3) 71 (2.0) 200 (1.5)
Walking time ≥ 30 min/day 5,952 (60.4) 1,904 (53.7) 7,856 (58.6)
Missing 890 (9.0) 403 (11.4) 1,293 (9.6)
Household income ≥ 3,000,000 yen/year 5,389 (54.6) 1,488 (42.0) 6,877 (51.3)
Missing 1,404 (14.2) 666 (18.8) 2,070 (15.4)
Numbers of comorbidity 1 3,415 (34.6) 1,239 (34.9) 4,654 (34.7)
≥ 2 4,516 (45.8) 1,614 (45.5) 6,130 (45.7)
Missing 0 (0.0) 0 (0.0) 0 (0.0)

7. Table 1 – please change the < signs into > for education, walking time and income? Otherwise I have trouble understanding the effects.
8. Table 1 – please clarify the title – multinomial logistic regression – reference category =… No disability.
9. Correct footnote Table 1 – only the effect of social participation is adjusted for these confounders – age effects are also adjusted for social participation etc. Leave out footnote here?
10. Could you also provide p-values or indicate levels of statistical significance?

RESPONSE:
In accordance with your suggestions, we revised Table 1 and the results section as follows:

Table 1. Multinomial logistic regression analysis: Association between social participation and the need for LTC or death at 9.4 years (N = 9,741) AOR (95% CI) - Reference category: No disability
Survival with
the need for LTC Death
845 (8.7) 2,443 (25.1)
Variable AOR (95% CI) AOR (95% CI)
Social participation (yes) 0.82 (0.69-0.97)* 0.78 (0.70-0.88)**
Age (per 5 years) 2.06 (1.93-2.19)** 2.16 (2.06-2.26)**
Gender (men) 0.80 (0.67-0.95)* 1.98 (1.76-2.24)**
Family (living alone) 1.03 (0.78-1.31)a 0.91 (0.74-1.11)a
Educational attainment
(more than 9 years) 0.92 (0.79-1.08)a 0.94 (0.85-1.05)a
Smoking (yes) 1.50 (1.19-1.88)** 1.74 (1.51-2.00)**
Alcohol (yes) 1.05 (0.86-1.30)a 0.92 (0.81-1.05)a
Walking time (more than 30 min/day) 0.80 (0.69-0.94)** 0.73 (0.66-0.81)**
Household income
(more than 3,000,000 Yen/year) 0.88 (0.75-1.03)a 0.96 (0.86-1.07)a
1 comorbidity 1.39 (1.10-1.75)** 1.28 (1.10-1.50)**
2 or more comorbidities 1.59 (1.27-1.98)** 1.67 (1.45-1.94)**
*: $p<0.05$, **: $p<0.01$.
Note: LTC, long-term care; AOR, adjusted odds ratio; CI, confidence interval.

11. Discussion: Reformulate first sentence – loss of healthy aging?

RESPONSE:
Per your comments, we have corrected the discussion phrases as follows: (page 13, para 3)

“This study showed the association between social participation and the need for LTC or death during 9.4 years of follow-up.”

12. Discussion: I find it difficult to believe that this is the first longitudinal study examining the association between social participation and health/mortality. How about f.ex. Yu, Sessions,Fu & Wall.

Soc Sci Med. 2015 A multilevel cross-lagged structural equation analysis for reciprocal relationship between social capital and health? Or: Hsu: Does social participation by the elderly reduce mortality and cognitive impairment? Other studies might have used concepts measuring similar activities, but not called it social participation but f.ex social engagement.

RESPONSE:
We appreciate your valuable comment. As you pointed out, Ge Yu et al. study social participation and various health outcomes, and Hsu (2007) showed the relationship between social engagement and cognitive impairment and mortality. However, Ge Yu (2015) did not investigate the relationship between social participation and mortality, and Hsu (2007) did not research the relation to the need for care support. We consider that our study is valuable because we used composite outcomes to examine the relationship between the need for care support and mortality and the elderly's relevant outcomes. However, in accordance with your suggestion, we have revised the phrases in the discussion section. (page 14, para 2)

"The strength of the present study is that it is the first study to use composite outcomes for both the need for care support and death to examine the relationship between social participation and the elderly's relevant outcomes."

13. Discussion p13: Further studies are needed to reveal… healthy aging. This is a little too easy. Could you be more precise and indicate what and how? What kind of study would you suggest that takes this field further and that accounts for the limitations described? The WHO emphasizes the role of the community (see f.ex. https://www.who.int/social_determinants/thecommission/countrywork/within/socialparticipation/en/). With your system of home visits that would perhaps constitute a feasible way to propel this field forward. The discussion could benefit from tying the findings closer to public health policy and interventions in local (community) settings.

RESPONSE:
Thank you for your insightful comments. We have rephrased this as follows: (page 14, para 1)

"Further studies are needed to reveal the underlying mechanisms regarding the relationship between social participation and healthy aging, i.e., what kind of form or content of participation may sustain the health of older people or how many frequencies of social participation may maintain a participant's health or their health-related behaviors."

VERSION 2 – REVIEW

REVIEWER	Marijke Veenstra NOVA, Oslo Mettropolitan University, Norway
REVIEW RETURNED	15-Aug-2019

GENERAL COMMENTS	Thanks to the authors for submitting a revised version and addressing the concerns and comments expressed in my first review. I appreciate to see that mistakes have been corrected. I still value the study design (AGES), the structure of the paper and the clarity of research questions and analyses. The authors clearly attempted to address my first concern by including the WHO definition of social participation in the introduction. However, this is not integrated in the rest of their text. As for now it is mostly a direct (almost cut and paste) definition, which the authors do not actively tie back to their research questions or integrate in the discussion. As a reader I am left to find out how this may be relevant. Hence, this does not contribute to the quality of the paper.

	My concern about what triggers a home visit targets the definition of your outcome – need for LTC – in relation to the reference category (no disability) and is still not sufficiently addressed. Here I would expect a more clear description of the objective (and subjective) criteria for certifications for LTC in the Japanese system – an indication about needed level of care/level of functioning. This also provides information about the definition of Your reference category (no disability - actually - no need for LTC). The added text at p7 still leaves this definition very open and very much up to the patient or his/her family. NB - if the Authors decide to use "need for LTC" as defined outcome, this should be updated throughout the document, also in the texts and the supplemental tables. The authors still disregard relevant existing international, as well as recent national literature on the field (e.g BMJ Open: Reduced long-term care cost by social participation among older Japanese adults: a prospective follow-up study in JAGES). This makes its contribution to the state of the art less clear and as a reader I am uncertain about the author's grasp of the literature on this topic. As for now, it has almost exclusively empirical value, with one main strength compared to previous research: the inclusion of both need for care and mortality in one single model. Using multinominal models as the authors used in their current paper may be one way to do this. The two outcomes are however compared separately to the reference category («no disability»), so that the advantages over models and studies addressing need for LTC and mortality separately seem rather limited. The manuscript would benefit from a Language check (UK English).

VERSION 2 – AUTHOR RESPONSE

Response to Reviewer 2
Thanks to the authors for submitting a revised version and addressing the concerns and comments expressed in my first review. I appreciate to see that mistakes have been corrected. I still value the study design (AGES), the structure of the paper and the clarity of research questions and aanalyses. The authors clearly attempted to address my first concern by including the WHO definition of social participation in the introduction. However, this is not integrated in the rest of their text. As for now it is mostly a direct (almost cut and paste) definition, which the authors do not actively tie back to their research questions or integrate in the discussion. As a reader I am left to find out how this may be relevant. Hence, this does not contribute to the quality of the paper.

RESPONSE:
First, we appreciated your comments. We have reflected on our first revision and added the following sentences to the discussion section as follows:
(page 14, para 3)
“We defined and classified social participation from the baseline questionnaire to a binary variable denoting the presence or absence of any social participation and adopted onto the main analysis. Further, we conducted secondary analysis using the original eight-type classification of social participation based on the JGSS questionnaire.[18] The results of the secondary analysis showed that several types of social participation were associated with lower incidences of LTC and mortality. In contrast, several types of social participation were not associated with lower incidences of LTC and mortality. Many authors and the WHO had difficulty clearly and concretely defining social participation

[5-7], and our results indicated that specific types of social participation may be effective for long-term care and mortality. From the various perspectives of politics, economics, and other academic fields, we should detect the types of social participation that are more effective for the elderly."

My concern about what triggers a home visit targets the definition of your outcome – need for LTC – in relation to the reference category (no disability) and is still not sufficiently addressed. Here I would expect a more clear description of the objective (and subjective) criteria for certifications for LTC in the Japanese system – an indication about needed level of care/level of functioning. This also provides information about the definition of Your reference category (no disability - actually - no need for LTC). The added text at p7 still leaves this definition very open and very much up to the patient or his/her family.

RESPONSE:
Thank you for your interesting suggestion. We agree with your comment and have reflected this in the methods section as follows: (page 7, para 1)

"When applicants are certified, they would be classified as Needed Support or need for LTC. The applicants with lighter functional decline are classified as Needed Support. The LTC certification is generally considered as the activities of daily life (ADL) that the applicant partially or wholly depends on others for.[20] We also defined the reference category as 'without need for LTC', and the category included those who were not certified or certified as Needed Support."

NB - if the Authors decide to use "need for LTC" as defined outcome, this should be updated throughout the document, also in the texts and the supplemental tables.

RESPONSE:
In accordance with your suggestion, we have checked again and changed 'functional disability' to 'need for long-term care (LTC)' and the reference category 'no disability' to 'without need for LTC'.

The authors still disregard relevant existing international, as well as recent national literature on the field (e.g BMJ Open: Reduced long-term care cost by social participation among older Japanese adults: a prospective follow-up study in JAGES). This makes its contribution to the state of the art less clear and as a reader I am uncertain about the author's grasp of the literature on this topic.

RESPONSE:
Thank you for alerting us to our insufficient literature search. We have checked the literature and added additional sources to the references: (pages 19-22)

As for now, it has almost exclusively empirical value, with one main strength compared to previous research: the inclusion of both need for care and mortality in one single model. Using multinominal models as the authors used in their current paper may be one way to do this. The two outcomes are however compared separately to the reference category («no disability»), so that the advantages over models and studies addressing need for LTC and mortality separately seem rather limited.

RESPONSE:
We appreciate your suggestion. We have added phrases about our study's limitations as follows: (page 15, para 4)

"Fourth, multinomial logistic analysis may be superior to previous methods to compare the elderly's need for LTC and death without need for LTC, but other methods such as the competing risk regression model may be suggested when we focus separately on the incidence of LTC."

The manuscript would benefit from a Language check (UK English).

RESPONSE:
Thank you for your comment. We have used Editage (www.editage.jp) for a language check, corrected our paper to UK English.

VERSION 3 – REVIEW

REVIEWER	Marijke Veenstra NOVA, OsloMet
REVIEW RETURNED	25-Sep-2019

GENERAL COMMENTS	I still think the paper is very thin on international literature on the topic of social participation. I also think the paper would benefit from an extra (native UK) language check. For the rest some minor comments: P4 – 22: "These populational transitions have enormous influence on access to **high** quality health and social care." Add "high"? Delete: ." and the opportunities that ageing bring". I appreciate that the authors added opportunities but it does not fit in this sentence. The next sentence from the WHO is sufficient for these purposes. P 7 15-22: "When applicants are certified, they would be classified as Needed Support or need for LTC. The applicants with lighter functional decline are classified as Needed Support. The LTC certification is generally considered as the activities of daily life (ADL) that the applicant partially or wholly depends on others for.[20] We **(delete also**) defined the reference category as 'without need for LTC' and **this** category included those who were not certified or certified as Needed Support". This is clarifying, although the distinction between Needed Support and LTC is still a little vague. I would have liked to see more objective criteria as the foundation of LTC decisions, and am a little surprised that this does not seem to be the case, but ADL comes close enough. Just some minor language suggestions (in bold). P13 30-35: "In sensitivity analysis, the results indicated that participants with participation in social groups were less likely to develop XXXX what? (here it probably should say: A need for social support) than those without participation (AOR= 0.93; 95% CI: 0.81-1.07)" Outcome measure is lacking in this sentence. P13 52-57: "Furthermore, a relationship was seen between the number of types of social participation and each outcome, suggesting the robustness of the results." Not very clear how is this a test of robustness. The interesting finding is that it is actually not one activity but preferably at least three that seems to have an effect? Is there any reason why you did not highlight that? P14 27-43: "The results of the secondary analysis showed that several types of social participation were associated with lower incidences of LTC and mortality.. **Many authors and the WHO had difficulty clearly and concretely defining social participation [5-7], and our results indicated that specific types of social**

	participation may be effective for long-term care and mortality. From the various perspectives of politics, economics, and other academic fields, we should detect the types of social participation that are more effective for the elderly." Delete sentence "Many authors and the WHO… social participation" . Not relevant here. I guess you mean to say something like that social participation is a broad construct and difficult to define/operationalise? But if you want to start that in the discussion you should say more about it and more importantly, include many more references to theory. The second part of this sentence is a repetition of the previous. So I suggest you delete this sentence. In addition to the general finding – two other findings are of potential interest. 1. It seems to be participation in more than 2 acitivities that is positively related to reduced risk for need for LTC and mortality. One does not seem to be enough? 2. Your study actually provides some insights into which types of social participation may be effective. You can exploit this better, at least you should repeat what types of social participation seemed to be most effective according to your study. And then I would have liked some reflection on what local (or national) policies could do with this. This concerns the second part "rom the various perspectives of politics, economics, and other academic fields, we should detect the types of social participation that are more effective for the elderly." You have actually tried to do this already have you not? Why not use it? P60 55-60 Competing interests – «the authors have no conflicts» I think the correct statement is the authors have no conflicts to declare – or just: none declared.

VERSION 3 – AUTHOR RESPONSE

Reviewer: 2
Reviewer Name: Marijke Veenstra
Institution and Country NOVA, OsloMet

I still think the paper is very thin on international literature on the topic of social participation. I also think the paper would benefit from an extra (native UK) language check.

RESPONSE:
We appreciate your valuable comment. We have considered all your comments and fixed issues per your suggestion.
Regarding your comment on the paper being thin on international literature on the topic of social participation, we respectfully disagree because, as we indicated on the discussion, we showed social participation may have a some contribution to show values for healthy ageing, not only functional decline but also mortality. You showed on the previous comment that the paper "Reduced long-term care cost by social participation among older Japanese adults: a prospective follow-up study in JAGES" dealt with deceased participants were preliminary because of the short observational period and it was analysed separately from the other participants. Our study may compensate for this study's result. We believe our study has a new value for BMJ Open.
We have asked an external native English language speaker to check the language of our manuscript again, and have added their name to the acknowledgements.

For the rest some minor comments:
P4 – 22: “These populational transitions have enormous influence on access to **high** quality health and social care.”
Add “high”?
Delete: .” and the opportunities that ageing bring”. I appreciate that the authors added opportunities but it does not fit in this sentence. The next sentence from the WHO is sufficient for these purposes.

RESPONSE:
Thank you for your important comment. We agree and have reflected your opinion as follows: (page 4, para 1)

“These populational transitions would have enormous influence on our access to high quality health and social care.”

P 7 15-22: “When applicants are certified, they would be classified as Needed Support or need for LTC. The applicants with lighter functional decline are classified as Needed Support. The LTC certification is generally considered as the activities of daily life (ADL) that the applicant partially or wholly depends on others for.[20] We **(delete also**) defined the reference category as 'without need for LTC' and **this** category included those who were not certified or certified as Needed Support”.

This is clarifying, although the distinction between Needed Support and LTC is still a little vague. I would have liked to see more objective criteria as the foundation of LTC decisions, and am a little surprised that this does not seem to be the case, but ADL comes close enough. Just some minor language suggestions (in bold).

RESPONSE:
Thank you for your comment. We have reflected this in the methods section as follows: (page 7, para 1)

“Applicants or their family members essentially apply to their municipality for certification of LTC when the applicants find themselves in the need of some care support or users’ family members recognise that they need to introduce care support in the user’s life. When applicants are certified, they would be classified as Needed Support or the need for LTC. The applicants with lighter functional decline (e.g. those who are ambulatory but find it difficult to walk long distances) are classified as Needed Support. The LTC certification is generally considered as the activities of daily life (ADL) that the applicant partially or wholly depends on others for.[20] We defined the reference category as 'without the need for LTC' and this category included those who were not certified or certified as Needed Support.”

P13 30-35: “In sensitivity analysis, the results indicated that participants with participation in social groups were less likely to develop XXXX what? (here it probably should say: A need for social support) than those without participation (AOR= 0.93; 95% CI: 0.81-1.07)”
Outcome measure is lacking in this sentence.

RESPONSE:
Thank you for your suggestion. We have added the outcome measure as follows: (page 13, para 2)

“In sensitivity analysis, the results indicated that participants who participated in social groups were less likely to develop the need for Needed Support than those who were not (AOR= 0.93; 95% CI: 0.81-1.07); however, the results were not statistically significant (Supplementary Table S3).”

P13 52-57: “Furthermore, a relationship was seen between the number of types of social participation

and each outcome, suggesting the robustness of the results."

Not very clear how is this a test of robustness. The interesting finding is that it is actually not one activity but preferably at least three that seems to have an effect? Is there any reason why you did not highlight that?

RESPONSE:
Thank you for pointing this out. We agree with your comment and have reflected it and added the following: (page 13, para 3)

"Furthermore, a relationship was seen between the number of types of social participation and each outcome, suggesting that engaging in many varieties of participation may be more effective on the health of participants than a few varieties of participation."

P14 27-43: "The results of the secondary analysis showed that several types of social participation were associated with lower incidences of LTC and mortality.. **Many authors and the WHO had difficulty clearly and concretely defining social participation [5-7], and our results indicated that specific types of social participation may be effective for long-term care and mortality.** From the various perspectives of politics, economics, and other academic fields, we should detect the types of social participation that are more effective for the elderly."
Delete sentence "Many authors and the WHO… social participation" . Not relevant here. I guess you mean to say something like that social participation is a broad construct and difficult to define/operationalise? But if you want to start that in the discussion you should say more about it and more importantly, include many more references to theory. The second part of this sentence is a repetition of the previous. So I suggest you delete this sentence.

RESPONSE:
Thank you for the advice. We agree and have revised the sentence as follows: (page 14, para 3)

"The results of the secondary analysis showed that several types of social participation were associated with lower incidences of LTC and mortality. Our results indicated that specific types of social participation may be effective for long-term care and mortality. Although it was difficult for us to know the detailed contents of these forms of participation from the baseline questionnaire, local community, hobby groups, and sports groups or clubs may be effective in contributing to participants' future health. In particular, our results indicate that participation in sports groups is the most effective form of social participation listed in our questionnaire. Previous studies have revealed that participation in sports clubs means that participants would be less likely to develop the need for LTC than if exercising alone.[8] Therefore, participation in sports clubs may contribute to healthy ageing."

In addition to the general finding – two other findings are of potential interest.
1. It seems to be participation in more than 2 acitivities that is positively related to reduced risk for need for LTC and mortality. One does not seem to be enough?

RESPONSE:
Thank you for your suggestion. As you indicated above, we have added the following sentence: (page 13, para 3)

"Furthermore, a relationship was seen between the number of types of social participation and each outcome, suggesting that many varieties of participation may be more effective on the health of participants than a few varieties of participation."

2. Your study actually provides some insights into which types of social participation may be effective.

You can exploit this better, at least you should repeat what types of social participation seemed to be most effective according to your study. And then I would have liked some reflection on what local (or national) policies could do with this.
This concerns the second part "rom the various perspectives of politics, economics, and other academic fields, we should detect the types of social participation that are more effective for the elderly." You have actually tried to do this already have you not? Why not use it?

RESPONSE:
In accordance with your suggestions, we considered that social participation has quite a few varieties in terms of contents and that these contents will become more complicated as our lifestyles become more multifaceted. Therefore, we described the necessity of future research. We changed some sentences as follows: (page 14, para 3)

"…that specific types of social participation may be effective for long-term care and mortality. Although it was difficult for us to know the detailed contents of these forms of participation from the baseline questionnaire, local community, hobby groups, and sports groups or clubs may be effective in contributing to participants' future health. In particular, our results indicate that participation in sports groups is the most effective form of social participation listed in our questionnaire. Previous studies have revealed that participation in sports clubs means that participants are less likely to develop the need for LTC than if exercising alone.[8] Therefore, participation in sports clubs may contribute to healthy ageing so we might as well recommend the national and local politics to grow more interests in the participation in sports clubs or groups."

P60 55-60 Competing interests – «the authors have no conflicts»
I think the correct statement is the authors have no conflicts to declare – or just: none declared.

RESPONSE:
We have added "to declare" in the following sentence: (page 16, para 4)

"The authors have no conflicts to declare."