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# Association between vision impairment and participation in older Adults - A Hunt4 70+ Study

Master's thesis in Physical Activity, Health and Occupational Science

Supervisor: Prof. Beatrix Vereijken

Co-supervisor: Skender Elez Redzovic & Yi-Qian Sun

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Norwegian University of Science and Technology  
Faculty of Medicine and Health Sciences  
Department of Neuromedicine and Movement Science



Kunnskap for en bedre verden



# ASSOCIATION BETWEEN VISION IMPAIRMENT AND PARTICIPATION IN OLDER ADULTS

## A HUNT4 70+ STUDY BASED ON ICF FRAMEWORK

### Background



Of the world's older persons will live in the developed region by 2050.



one in nine people in Norway are aged 70 years or over, and this percentage is set to increase.



### Research question



Does participation in older adults differ depending on the degree of Vision impairment?

### Participants

**6,152 70+ years Older Adults**



MALE

46.9%



FEMALE

53.1%

### ICF participation

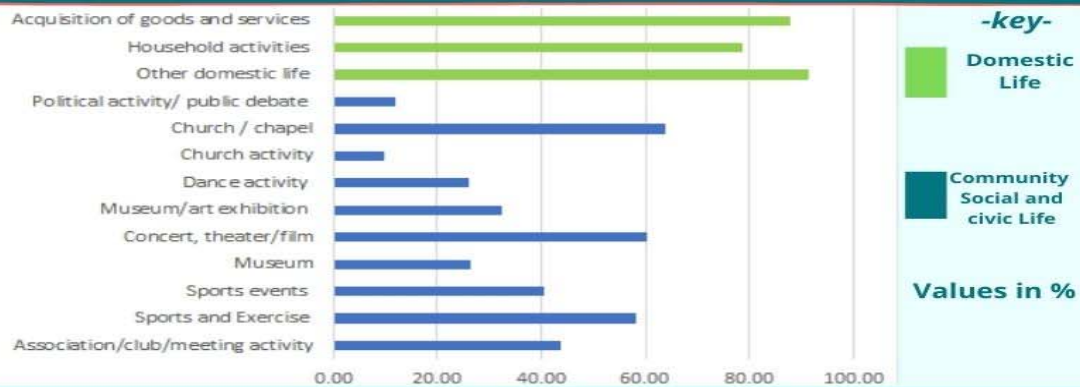
#### Participation - Involvement in Life Situation

- Contributes to successful aging
- Promotes physical and mental health
- Helps prevent illness

#### Participation Domains

- Domestic life
- Community, social and civic life
- Major Life Area
- Interpersonal Interaction and relationship

Positive responses in percentages to performance participation in domestic life and community, social and civic life and civic in life areas



### LOGISTIC REGRESSION

**62%**

**\*SEVERE VI**

Increased risk of participating less in domestic life, compared to not impaired group.

**37%**

OR, not significantly associated with the risk of participating less in community, social and civic life.

**Risk of participating less in domestic life decreases for moderate and slight VI**

### Conclusions

- DEGREE OF VISION IMPAIRMENT WAS ASSOCIATED WITH LOWER LEVEL OF PARTICIPATION IN DOMESTIC LIFE. BUT HAS NO EFFECT IN COMMUNITY SOCIAL AND CIVIC LIFE
- MORE PARTICIPATION IN DOMESTIC LIFE COMPARED TO COMMUNITY, SOCIAL AND CIVIC LIFE
- ASSOCIATION WAS NOT STATISTICALLY SIGNIFICANT FOR COMMUNITY, SOCIAL AND CIVIC LIFE AFTER ADJUSTING FOR CONFOUNDERS

### STUDY IMPACTS

Help policy makers make better decision.

Increases participation

Improves health, well being, active aging & quality of life.

Reference  
 statistics norway website SSB 2021  
 WHO, 2001, UN, 2017



\*Adjusted for Confounders; Age, Health status, Sex, Joint pain, Musculoskeletal pain, Education, Motor ability impairment  
 \*OR: Odds ratio  
 \*VI- vision impairment

## ACKNOWLEDGEMENTS

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## ABSTRACT

**Objective:** The aim of this study was to examine whether there is an association between vision impairment (VI) and participation in older adults, depending on the degree of VI, using a large, Norwegian dataset.

**Method:** This cross-sectional study included vision impaired older adults (70+ years, n = 6,152) who participated in the HUNT4 70+ and TRONDHEIM 70+ health studies, which were part of the fourth data collection wave of the HUNT study (2018 -2019). In accordance with the World Health Organizations international classification of functioning disability and health (ICF), we assessed participation in two of the four domains, namely domestic life and community, social and civic life. Comprehensive information about participation was based on questions concerning activities of daily living (ADL), lifestyle, health status, and chronic conditions. To assess the associations, information on the degree of VI (exposure) was examined with a crude logistic regression analysis in relation with participation domains (outcome), followed by adjusted logistic regression analysis. In addition, we also assessed the level of participation reported by the participants.

**Results and Discussion:** Severe VI was significantly associated with increased risk of participating less in domestic life (OR = 1.62 95%CI = 1.18 – 2.22) after adjusting for covariates (age, sex, education, joint pain, health status musculoskeletal pain, motor ability impairment,) but had no significant influence on participation in community, social and civic life (OR = 1.37, 95% CI = 0.89 – 2.12). The risk decreased for moderate VI (OR 1.03; 95%CI =0.83 to 1.28), and slight VI (OR 1.04; 95%CI 0.88 to 1.24) in domestic life although not statistically significant. A smaller sample size for the severe impairment (n=350) compared to moderate and slight VI could be a reason for this. Participant's responses showed that older people with VI participated more in domestic life compared to community, social and civic life.

**Conclusion:** Participation is important for maintaining quality of life and healthy aging. It could also inform better policy making. This study showed that the degree of VI is associated with increased risk participating less in domestic life, but has no effect on community, social and civic life. These results underline the need for more studies to investigate the reasons why VI has more impact on domestic life compared to community, social and civic life.

**Key words:** Participation, Older adults, Vision impairment, Activities of daily living, HUNT4, ICF.

## LIST OF FIGURES

**Figure 1:** ICF framework (WHO, 2001b).

**Figure 2:** Flow diagram of the selection process for analytical sample (inclusion, exclusion and number of participants) from HUNT4 70+ and Trondheim 70+.

**Figure 3:** Directed acyclic graph (DAG), illustrating the association between exposure (vision impairment), outcome (participation) and covariates.

**Figure 4:** Positive responses in percentages to performance participation in domestic life and community, social and civic life. Green bars represent the domestic life domain. Blue bars represent the community, social and civic life domain..

## LIST OF TABLES

**Table 1:** Sociodemographic and baseline characteristics of participants in HUNT4 (Trondheim) 70+ (n = 6,152), stratified by the independent variable (vision impairment).

**Table 2:** Distribution of responses of performance of participation for the domains of participation, stratified by vision impairment.

**Table 3:** Crude model and adjusted model for the association between degree of VI and participation in domestic life.

**Table 4:** Crude and Adjusted model for the association between degree of VI and participation in community, social and civic life.



## ABBREVIATIONS

ICF	International classification of functioning, disability and health
ADL	Activities of daily living
WHO	World health organization
DAG	Directed acyclic graph
REK	Regional Committees for Medical and Health Research Ethics
OR	Odds ratio
CI	Confidence Interval
VI	Vision Impairment
QOL	Quality of life
HUNT	Trøndelag Health Study

## TABLE OF CONTENT

<b>ACKNOWLEDGEMENTS</b> .....	1
<b>ABSTRACT</b> .....	2
<b>LIST OF FIGURES</b> .....	3
<b>LIST OF TABLES</b> .....	3
<b>ABBREVIATIONS</b> .....	4
<b>1.0 Background</b> .....	7
<b>1.1 Aging population</b> .....	7
<b>1.2 Vision impairment</b> .....	8
<b>1.3 Vision impairment and Quality of life (QOL)</b> .....	9
<b>1.4 ICF as a theoretical framework</b> .....	9
<b>1.5 Participation</b> .....	10
<b>1.6 Participation in relation to older adults and daily life</b> .....	11
<b>1.7 Participation in relation to physical activity for Vision-Impaired older adults</b> .....	12
<b>1.8 Problem Statement</b> .....	13
<b>2.0 Study Objective</b> .....	15
<b>2.1 Research question</b> .....	15
<b>3.0 Methods</b> .....	16
<b>3.1 Study design</b> .....	16
<b>3.2 Study participants</b> .....	16
<b>3.3 Measurements</b> .....	17
<b>3.3.1 Demographic and socioeconomic information</b> .....	18
<b>3.3.2 Vision impairment as an exposure variable</b> .....	18
<b>3.3.3 Participation as an outcome variable</b> .....	18
<b>3.4 Covariates</b> .....	20
<b>3.5 Ethical considerations and risk assessment</b> .....	20
<b>3.6 Statistical Analysis</b> .....	21
<b>3.7 Missing data</b> .....	22
<b>4.0 Results</b> .....	22
<b>4.1 Baseline characteristics of the study population</b> .....	22
<b>4.2 Association between the degree of VI and participation in domestic life</b> .....	27
<b>4.3 Association between the degree of VI and community, social and civic life</b> ... 28	
<b>5.0 DISCUSSION</b> .....	30
<b>5.1 Main findings</b> .....	30

<b>5.2</b>	<b>Comparison with previous studies</b> .....	31
<b>5.3</b>	<b>Strengths</b> .....	32
<b>5.4</b>	<b>Limitations</b> .....	33
<b>6.0</b>	<b>Conclusion</b> .....	33

# 1.0 Background

## 1.1 Aging population

Positive experience in aging and longevity involves steady opportunities for health, participation, and security (WHO, 2002). As the aging population rapidly increases, with especially those of 80 years or over projected to increase from 137 million to 425 million globally between 2017 and 2050 (UN, 2017), it has become pertinent that governments implement policies that aim at addressing the challenges and needs of the older population, ranging from health care, social protection, and other forms of generational solidarity (UN, 2017). Although 2/3 of the world's older persons live currently in developing regions, 80% of the world's older persons will live in the developed region by 2050, with Europe having as much as 35% of its population consisting of older persons (UN, 2017). According to the statistics Norway website (*Population - SSB*, 11<sup>th</sup> March 2021) “over one in nine people in Norway are aged 70 years or over, and this percentage is set to increase. In the medium alternative, roughly every 5<sup>th</sup> person in Norway will be aged 70 or over by 2060.”

Fertility decline and increasing life expectancy are the leading factors influencing aging globally (UN, 2017). According to UN, (2017), women are likely to have higher longevity than men; women’s life expectancy surpassed that of men by 4.6 years globally in 2010 – 2015 and their survival advantages continue even at old age. Females' chances of survival at age 60 were largest in Europe with 4.0 years and smallest in Africa with 1.6 years, whereas Norway recorded a life expectancy of 84.3 years for women and 80.9 years for men in 2017 (NIPH, 2018).

Independence is an important goal both for individuals and society at large, including the health care system and policymakers (WHO, 2002). Maintaining independence as one ages is influenced by several factors such as economic conditions, support systems, and health status (UN, 2017). The aging population will likely cause increased pressure on the health care system and government expenses. Therefore, it is paramount for the elderly and the society as a whole to maintain good health, as well as a high level of function into old age (Storeng., 2017).

According to Hebert (2020), 12% of those more than 75 years of age experiences an annual reduction in function. In addition, aging can also gradually change the manner of spending time and the activities people perform, both because of changing life situations and increasing

functional declines, such as reduced strength and endurance, and disabilities such as vision impairment (VI) (Desrosiers et al., 2009a; Law, 2002).

According to WHO, (2019b), the aging population will lead to a significant increase in the number of individuals with eye conditions that cause VI. Advanced age is known to be a primary risk factor for most eye problems WHO, (2019b) including visual function, which is known to be one of the major concerns of older people (Ramrattan et al., 2001). Restrictions due to VI and other outcomes of aging are a potential threat to older persons' independence in performing daily activities (Alma et al., 2010a).

## **1.2 Vision impairment**

According to the international classification of functioning, disability, and health (ICF), an "Impairment" is a term used to describe a "problem in the function or structure of a person's body" (WHO, 2013a pg 8). The International Classification of Disease injuries and causes of death (ICD 10, VI categories 1 to 5) defined VI in 6 categories that represent mild or no VI for category 0 with visual acuity of 6/18, moderate VI for category 1 with visual acuity of 6/18 - 6/60, severe VI for category 2 with visual acuity 6/60 - 3/60, and blindness in categories 3-5 with visual acuities of 3/60 - 1/60 or light perception, and no light perception, respectively (WHO, 2019).

Globally, cataract is the leading cause of vision loss, glaucoma is the second leading cause, while age-related macular degeneration (AMD) is the third leading cause of vision loss, and the majority of vision losses occurs with increasing aging (Resnikoff et al. 2004). As societies face a growing proportion of older people, the number of people with age-related macular degeneration and other causes of vision impairments is increasing as well (Resnikoff et al., 2004).

In the Norwegian public health report (NIPH, 2018) impaired sight is common among the elderly, and this condition was reported to influence the everyday functioning and social contact of many people in this group. According to WHO (2013b), about 80% of those that have vision loss and 65% of those that have moderate to severe vision loss were older than 50 years in 2010.

Although industrialized countries generally have a low prevalence of VI, Europe is expected to have increased VI prevalence due to increased life expectancy (Nowak & Smigielski, 2015; Skaat et al., 2012; Wolfram & Pfeiffer, 2012). According to studies on the prevalence

of blindness and VI (both near and far-sighted), out of 7.33 billion people alive in 2015, an estimated 36.0 million were blind, 216.0 million people had moderate to severe VI, and 188.5 had mild VI (Stevens et al., 2013). Bourne et al. (2017) stated that VI as well as age-related eye disease, affect economic and educational opportunities, can reduce the quality of life, and increase the risk of death.

### **1.3 Vision impairment and Quality of life (QOL)**

The onset of vision loss introduces a gradual decline in the QOL which even reduces more abruptly as visual field defects increases (Rein et al., 2007). Lamoureux and Pesudovs, (2011, pg 195) identified VI association with declined QOL as a “complex trait that encompasses vision functioning, symptoms, emotional wellbeing, social relationships, concerns and conveniences as they are affected by vision.” According to studies by Crews et al, (2017, pg 8) that examined the association of health-related QOL with the severity of vision among individuals aged 40 to 64 years, “there is a strong association between severity of self-reported visual impairment and poorer health-related quality of life”. This can also be related to an increased mortality rate of vision-impaired individuals in comparison with those who are not visually impaired as reported by (McCarty et al., 2001; Sweeting et al., 2020), although the reasons behind this remain obscure (McCarty et al., 2001; Sweeting et al., 2020).

### **1.4 ICF as a theoretical framework**

The World Health Organization’s (WHO) International Classification of Functioning, disability, and health (ICF) is a universally adopted framework that organizes and documents information concerning functioning and disability (WHO, 2001). It describes functioning as a dynamic interaction between health conditions, environmental factors, and personal factors, and provides definitions for functions and disability without classifying people themselves. ICF encompasses different models of disability including the medical model and social model and describes them as a “bio-psycho-social synthesis” (WHO, 2013a, p. 5). The ICF classification describes environmental factors as well as the role of health conditions as contributing to the creation of disability. It describes functioning and disability as umbrella terms, which indicate the positive and negative perspectives of functioning from a biological, individual, and social perspective. Figure (1) below illustrates the relationships described by

ICF. This framework will be employed in the current study when addressing VI and participation in older adults.

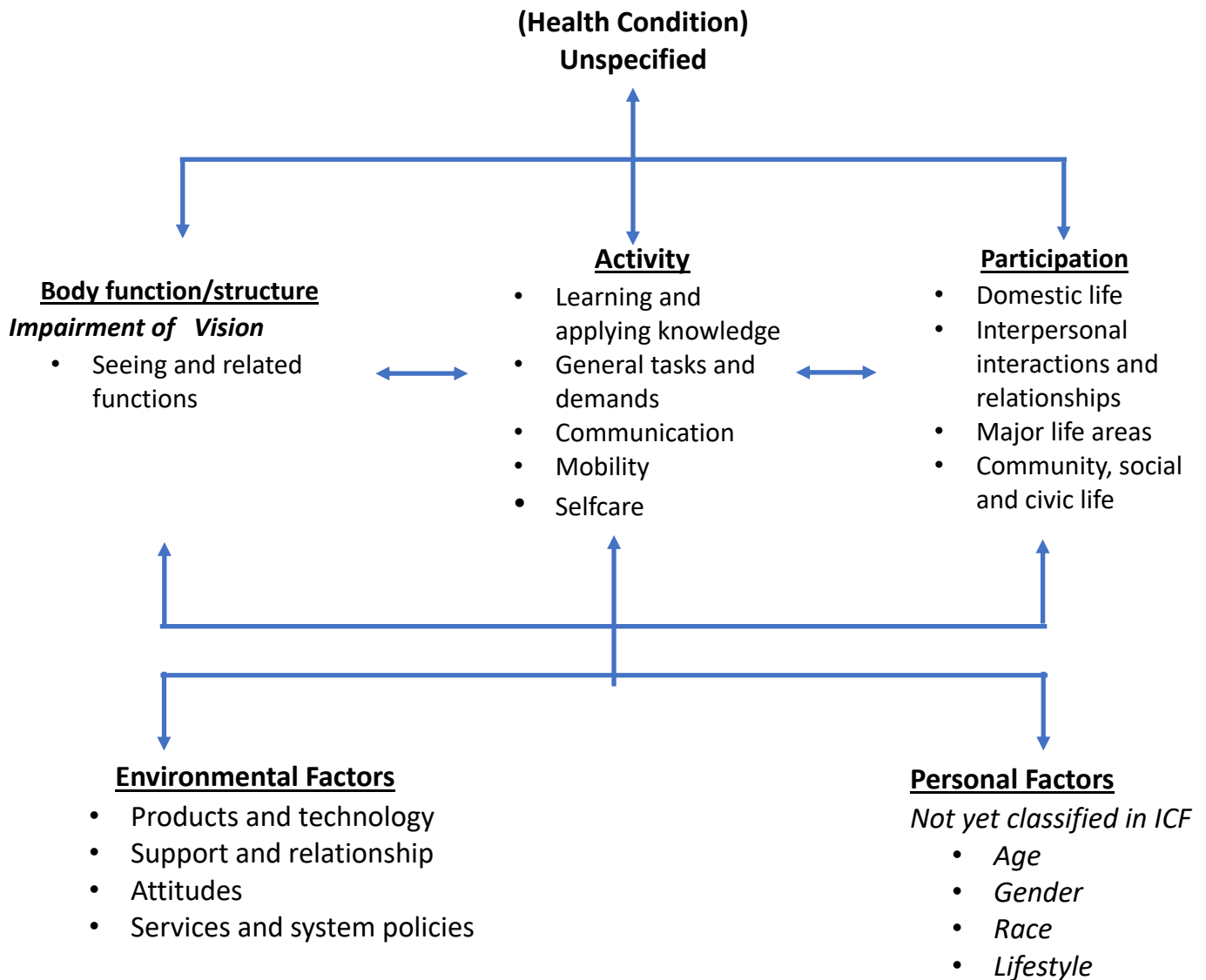


Figure 1. ICF framework (WHO, 2001b).

### 1.5 Participation

The WHO ICF defined participation as “involvement in life situation” (WHO, 2001, p. 10). Since the introduction of the concept of participation in the ICF in 2001, it has received steadily more importance (Piškur et al., 2014; WHO, 2001b), as participation has become very relevant as a way to better knowledge of the possible impact of impairment and disability in people’s life (Piškur et al., 2014; WHO, 2001b). Nevertheless, the concept of

participation remains obscure and has received a variety of definitions from different research studies.

According to ICF, there are nine different domains at the level of “activity and participation” as seen in Figure 1 above, this is presented as a single list in ICF and it covers several life areas (WHO, 2013). However, ICF gives room for several options to differentiate participation and activity (WHO, 2013). We have followed the method as used by Post et al. (2008), who defined four domains of participation: domestic life; interpersonal interactions and relationships; major life areas; and community, social, and civic life. According to WHO (2001) domestic Life has to do with carrying out domestic and everyday actions and tasks, which includes acquiring a place to live, food, clothing, and other necessities, household cleaning and repairing, etc. Interpersonal interactions and relationships involve doing things which are required for both basic and complex interactions with people. Major life areas include carrying out tasks and actions required to be involved in education, work and employment, and economic life. Community, social and civic life has to do with taking actions and tasks that are needed to be involved in organized social life outside the family in the community.

## **1.6 Participation in relation to older adults and daily life**

Vik et al. (2007) showed that participation plays an important role in successful aging as it promotes physical and mental health and helps prevent illness. Several studies have shown that older people want to continue to participate in society as they age (McGrath & Rudman, 2013; Vik et al., 2007). Carrying out general activities of daily living, for example, physical and social activities, taking a bath or shower, going to the toilet, dressing, and undressing, eating, going to bed, and getting up, is at the core of every human's functional independence and quality of life (Lamoureux et al., 2004). Therefore, having a clear understanding of participation includes the person's right to participate in his/her society having his/her right in controlling and conducting his or her life situation (Vik et al., 2007). However, from the age of 75 years, the level of participation often decreases, and older people can experience larger challenges and perceive more limitations in participating in daily life activities (Alma et al., 2010b).



Active participation in daily life activities is important for health and well-being, it helps one to achieve life satisfaction and a sense of competence which is important for our psychological, emotional, and skill development (Law,2002; Vik et al., 2007). Participation in everyday occupation plays an important role in every human's development as well as in lived experience (Law, 2002). It is through participation that we acquire skills and competencies, connect with others and our communities, and above all find purpose and meaning in our lives (Law, 2002).

The social and societal environment plays a role as either a barrier or facilitator for participation, it can increase the participation of the elderly with reduced functional abilities such as illness, or become a barrier to their participation. On the other hand, the environment can also be a source of motivation for the elderly population (Vik et al., 2007). Older people with VI may experience challenges with the physical environment, such as weather and season factors, and times of the day which could limit their independence and participation. However, they often create personal modifications and measures and make use of adaptive devices such as stand and handheld magnifiers, small telescopes, canes, lever doorknobs, etc., to maintain some level of independence in their participation in the occupation they desire (McGrath et al., 2013; Ratchford et al ., 2004).

### **1.7 Participation in relation to physical activity for Vision-Impaired older adults**

In today's world, physical inactivity has been established to be a major risk factor for morbidity and premature mortality (Brunes et al., 2017; Lee et al., 2012). Understanding the physical activity (PA) behavior of vision-impaired older adults is of great value, as participating in leisure-time PA has prevention benefits for several chronic diseases like cardiovascular disease, diabetes, cancer, hypertension, obesity, depression, osteoporosis, and premature death (Reiner et al., 2013; Sikorska-Siudek et al., 2006; Starkoff et al., 2017). As physical inactivity continues to be a public health concern, especially given the increase in the age of the population and increased incidence of chronic diseases (Brunes et al., 2019; Haskell et al., 2007), the Centre for Disease Control and Prevention and the American College of Sports recommends a habitual physical activity of at least 30 minutes of moderate to intense aerobic activity 5 days per week, or 20 minutes or more of vigorous-intensity aerobic PA at least 3 days per week (Haskell et al., 2007; Starkoff et al., 2017).

However, vision-impaired individuals typically spend less time in moderate to vigorous physical activities compared to individuals who do not have VI (Sweeting et al., 2020), and research has shown that individuals with VI have a higher likelihood of being inactive (Haskell et al., 2007; Kozub & Oh, 2004; Starkoff et al., 2017). Therefore, to maintain overall health and quality of life, it is also important to motivate vision-impaired individuals to participate in physical activity (Starkoff et al., 2017).

## **1.8 Problem Statement**

To the best of our knowledge, there are few earlier studies on participation in older adults that focus on VI especially using the Norwegian data set. This study is important as Norwegian “political consensus supported total right of inclusion and participation in the society for people with impairment” (Elizabeth A., 2013; *St.meld. nr. 40 (2002–2003)*, 2003, NOU, 2010:5) although the policy around people with impairment has moved from the perspective of care to human rights (Elizabeth A., 2013). Generally, there has been some earlier work on correlates of social participation in older adults with vision loss (Cimarolli et al., 2017) and the degree of participation of visually impaired elderly (Alma et al., 2012; Jin et al., 2019), but most of the earlier research on participation has focused on social participation only (Alma et al., 2010b, 2012; Bornman & Murphy, 2012; Desrosiers et al., 2005; Noreau et al., 2005). In the current study, we decided to be consistent with the definition of participation, as defined in the WHO ICF manual (WHO, 2001b).

Most cross-sectional studies reported that vision-impaired elderly participate in society, however, they tend to participate less in recreational activities (Alma et al., 2010b). In a study of 319 participants with a mean age of 78 years, Lamoureux et al. (2004) used the impact vision questionnaire (IVI) and revealed restrictions in leisure and mobility domains in visually impaired people. Also, Jin et al.'s (2019) study on social participation among seniors showed that there is reduced participation in sports/physical activities, family/friendship activities, service club/fraternal organization activities, volunteer/charity work, and educational/cultural activities among seniors with self-reported VI and glaucoma. Studies on participation limitations in elderly persons with VI have shown that this group faces more challenges as compared to those without VI. However, visual acuity as such, which is one of the measures of VI, was found not to be associated with participation (Desrosiers et al.,

2009a). So here as well, broader definition of VI could give more insight into the potential association between VI and participation.

Accordingly, there is need to investigate further the association between the degree of VI and participation in older adults. There are few studies that have examined issues related to the association between VI and participation in older adults, and to the best of our knowledge none have done so in a Norwegian context. Therefore, this current study aims to shed light as well as add to the body of knowledge by specifically exploring the association between the degree of VI and participation in older adults by using a large dataset from the HUNT study. Evidence from this study will help in providing practical and theoretical implications on the potential differences in participation depending on the degree of VI, thereby providing information that may support better policymaking.

## **2.0 Study Objective**

The main objective of the current study is to examine the association between the degree of VI and participation in older adults, using data from the HUNT4 70+ study, including HUNT4 Trondheim 70+. Participation is defined broadly as any involvement in life situations, and not limited to social participation.

## **2.1 Research question**

Does participation in older adults differ depending on the degree of VI?

We expect higher levels of participation in domestic life and community, social and civic life, in those with no or lower degrees of VI as compared to those with moderate to severe visual impairment.

## **3.0 Methods**

### **3.1 Study design**

This cross-sectional study is based on data from HUNT4 70+ and Trondheim 70+, which were part of the fourth data collection wave of the HUNT study. The HUNT Study is a longitudinal population health study in the former county of Nord-Trøndelag, Norway, and is one of the largest health studies in the world. The HUNT study includes questionnaire data, clinical measurements, performance tests, and different biological samples from people living in the north part of Trøndelag county. HUNT4 70+ is a specific sub-project of HUNT4 that focused on the health status of older adults aged 70+ in particular. As the original HUNT population study does not contain data from a larger city area, it was decided to supplement HUNT 4 70+ with an equivalent 70+ sample from Trondheim. HUNT4 Trondheim 70+ was co-funded by Helsedirektoratet, Aldring og helse, Trondheim Municipality, NTNU, and Nasjonalforeningen for folkehelsen.

### **3.2 Study participants**

Participants meeting eligibility for inclusion in the current study are those participants from HUNT4 70+/Trondheim 70+ that answered the questions about VI. Figure 2 below presents a flow diagram outlining the selection process of the analysis dataset (participant inclusion and exclusion).



**Figure 2.** Flow diagram of the selection process for analytical sample (inclusion, exclusion, and the number of participants) from HUNT4 70+ and Trondheim 70+.

### 3.3 Measurements

The participants in HUNT4 (Trondheim) 70+ were tested for nutritional status, mouth health, blood pressure, weight, height, cognitive function, and physical function. The participants were also asked to answer several comprehensive sets of questionnaires regarding physical and mental health, vision impairment, lifestyle, and activities of daily living (ADL), including cooking, doing dishes, cleaning, doing laundry, paying, shopping, washing, eating, and toileting.

### **3.3.1 Demographic and socioeconomic information**

To describe the participants included in the current analysis, the following variables about the participants and their immediate environment were used: age, gender, education, marital status, living condition, feeling depression.

Age (in years) was included as a continuous variable, while categorical variable includes gender (female, male), and education of the participants (divided into 6 categories, ranging from primary and lower secondary school to 4 years or more college or university). Marital status was defined as (unmarried, married, widow/widower, divorced, separated), living condition as (in your apartment/residence, in a retirement home, in a nursing home), feeling depressed as (no, a little, a good amount, very much).

Information about relevant chronic conditions that may influence the association between visual impairment and participation was identified with the following question “Do you suffer from any long-standing illness at least a year illness or injury of a physical or psychological nature that impairs the functioning of your daily life?” Motor ability impairment that affects function was defined as (not impaired, slight, moderate, severe). Musculoskeletal pain and pain in the joints during the past 12 months are defined as (no, yes). In addition, the health status of the participants was assessed with the following question “How is your health at the moment” (poor, not so good, good, very good).

### **3.3.2 Vision impairment as exposure variable**

Information about the degree of VI in this study was based on self-reported VI by the participants in the HUNT survey. This was assessed with the following question “Would you describe your VI as Not impaired, Slight, Moderate or Severe?” Answers were rated on a 4-point scale, where 1 represents not impaired, 2=slightly impaired, 3= moderately impaired, and 4= severely impaired.

### **3.3.3 Participation as outcome variable**

Information about participation was based on HUNT questions concerning activities of daily life, independence, and lifestyle, including functional fitness, friends and family, and local

neighbourhood. We measured participation in the current study in a similar way as defined by ICF, while adopting Post et al.'s (2008) designation of participation as described above. However, we limited our work to only two of these domains, namely domestic life and community, social and civic life. We did not include major life areas as this involves carrying out tasks and actions in education, work, and employment, and the participants in the current study were already retired. Similarly, the domain of interpersonal interactions and relationships involve executing actions and tasks that are needed for interactions with other people, such as strangers, friends, family members, and lovers, and the HUNT dataset does not include data that covers these areas.

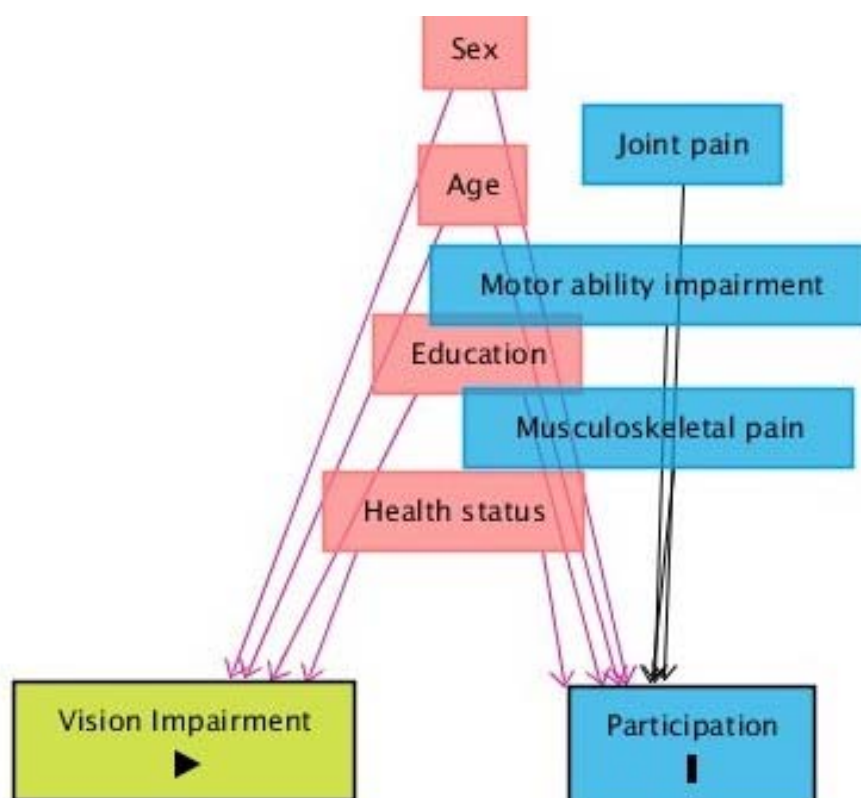
***Domestic Life:*** This involves acquisition of necessities (ADL shopping, ADL pay), Household tasks (which include, for example, wash, clean, dish, launch, cook, eat), and other areas of domestic life (for example bathing, dressing, toileting, go to bed, take medicine go to the bus, etc). These activities of daily living in HUNT were measured on a dichotomous scale of Yes/No. Missing values of ADL were regarded as “Yes”. In the current study, HUNT ADL variables were recoded and grouped to generate the domestic life variable, where “Yes” indicates the performance of participation or that they “participated in the ADL and social roles with no help” in all ADL variables and “No” indicates “participation in these activities with help or no participation” in any of ADL variables.

***Community, Social and Civic Life:*** This domain consists of involvement in Community life which includes engaging in activities (for example, association or club meeting /activity), Recreation and leisure (for example sports event, museum/art exhibition, sports/exercise), Religion and spirituality (church/chapel, parish work), Human rights, and Political life and citizenship (example political activity/ public debate). This was assessed with the following question: “How many times during the past 6 months have you been to culture and art exhibition, concert, theatre film, the church/chapel, a sporting event, museum/art exhibition?” To generate the community, social and civic life variable in the current study, we recoded the HUNT variables into a dichotomous variable, yes/never. Involvement/participation in these activities was measured as yes/never; yes, if participated 1-6 times /6months to 3 times/month/missing values in all these variables and never if no involvement/participation in any of these variables). Similarly, political activity and public debate, association or club meeting/ activity, music, singing or theatre, parish work, outdoor activities, dance, sports or exercise were also assessed with yes if 1 -5x/6 month to 1x/week and Never if none.



### 3.4 Covariates

Data about covariates were collected from the Hunt4 70+ data and defined based on previous literature and assumptions that the selected covariates may bias our findings in this study. We identified several confounding variables that could bias the association between VI and participation, as illustrated in a directed acyclic graph (DAG). This graph shows visually a minimal causal assumption and adjustment set for estimating the total effects of visual impairment on participation, see Figure (3).



**Figure 3.** Directed acyclic graph (DAG) illustrating the association between exposure (vision impairment) and outcome (participation) and covariates.

### 3.5 Ethical considerations and risk assessment

The HUNT population study is licensed as registered data. The license number for the HUNT4 data collection wave is 17 / 00426-7 / GRA. The HUNT4 Trondheim 70+ data

collection was approved previously by REK (ref. nr: 2016/1880). Before participation, informed consent was provided by the participants. Participation in HUNT4 (Trondheim) 70+ was voluntary, and the participants could leave the research study at any time without providing a reason. All collected data is registered and stored in the HUNT Database, and deidentified before handing over for research. The HUNT Database is a closed data solution without the possibility of connecting to the internet, which safeguards against hacking. Researchers in the current project did not have access to any personal data nor to the identification key ('koblingsnøkkel'). The data needed for this current project was temporarily stored on NTNU's password-protected servers and will be deleted at the end of the project period. In addition, the current study was approved by the regional committee for medical and health research ethics (REK) Norway (ref. nr.187347).

### **3.6 Statistical Analysis**

All data analyses were done in STATA version 16.0. Baseline sociodemographic characteristics were presented in the analysis dataset (n = 6,152). The baseline covariates were presented in percentages for categorical variables and as mean and standard deviation for continuous variables in the descriptive analysis.

Pearson's chi-square test for categorical covariates and ANOVA continuous covariates were used to investigate group differences in participants depending on the degree of visual impairment (Not impaired, Slight, Moderate, Severe), see Table 1. Pearson's chi-square was used in investigating the performance responses for different domains of participation, see Table 2.

The association between the degree of VI and participation was evaluated using logistic regression models, for the binary outcome measure of participation in Domestic life, and community social and civic life. Crude models and adjusted odds ratios (ORs) and 95% confidence intervals (CIs) were estimated, statistical significance was set at  $p = 0.05$ . A multivariable regression analysis was performed to control for potential confounders: Age, Sex, health status, education, motor ability impairment, joint pain, and musculoskeletal pain. The not impaired group was used as the reference group in the analyses.

### **3.7 Missing data**

Detailed information about the number of participants and missing data for each covariate are presented in Table 1 below.

## **4.0 Results**

### **4.1 Baseline characteristics of the study population**

Table 1 below shows the baseline descriptive characteristics of the 6,152-study participants from HUNT4 70+ and Trondheim 70+. The study population has an age range of 70 years to 104 years with a mean age of 82 years and consisted of more women than men (53.1% versus 46.9%) with approximately the same distribution within the category of their VI. However, there were more not impaired male participants compared to the female (n=936 versus n=790). There were less severely vision impaired participants compared to moderate, slight, and not impaired (5.7%, 17.2%, 49%, and 28% respectively). Generally, there were higher responses in slight VI than other categories of vision impairment. The majority of the participants (34.5%) had primary to lower secondary education compared with 1 – 2 years Academic or vocational education, (22.6%), 3 years Vocational school (6%), 3 – 4 years Vocational school (15.1%), < 4years college or University (11.4%), and > 4years College or University (8.3%). Furthermore, more participants reported living in their apartments (75%), compared with those that live in retirement homes (3.7%) and nursing homes (2.2%). (41.9%) of participants have not so good health condition compared to those that reported good (41.6%), very good (2.5%), and poor (4.8%) health. More participants reported slight motor ability impairment (33.1%). Most participants were not feeling depressed (68.8%).

Following a detailed description of the participant's responses to performance of participation, the study population responded more to participation in domestic life compared to community, social and civic life. A detailed description is shown in table 2 and figure 4.

**Table 1.** Sociodemographic, covariates, and baseline characteristics of participants in the current study (n = 6,152), stratified by the independent variable Vision impairment.

Characteristics	Value n (%)	Vision impairment				P-value*
		Not impaired n=1,726 (28%)	Slight n=3,017(49.0%)	Moderate n=1,059(17.2%)	Severe n =350 (5.7%)	
<b>Continuous variable</b>						
<b>Age</b> Mean $\pm$ SD      82.0 $\pm$ 6.4		79.3 $\pm$ 5.9	79.6 $\pm$ 6.2	80.8 $\pm$ 6.8	84.0 $\pm$ 7.0	<0.001
<b>Categorical variables</b>						
<b>Gender</b>						<0.001
Female	3,266 (53.1%)	790	1,611	645	220	
Male	2,886 (46.9%)	936	1,406	414	130	
<b>Living Condition</b>						<0.001
In your apartment	4,633 (75.3%)	1,351	2,343	755	184	
In retirement home	229 (3.7%)	39	93	54	43	
In Nursing home	135 (2.2%)	30	51	30	24	
Unknown**	1,155 (18.8%)	306	530	220	99	
<b>Education (In Years)</b>						<0.001
9 – 10 Primary & lower Secondary	2,125 (34.5%)	525	1,053	399	148	
1 – 2 Academic or vocation	1,391 (22.6%)	410	683	229	69	
3 - Vocational sch.	369 (6%)	104	172	73	20	
3 – 4 Vocational sch.	938 (15.1%)	263	463	167	45	
< 4yrs college or University	705 (11.4%)	218	362	96	28	
> 4yrs College or University	509 (8.3%)	180	242	67	28	
Unknown**	115 (1.87)	26	41	28	20	
<b>Marital Status</b>						<0.001
Unmarried	310 (5.04%)	85	160	49	16	
Married	3,492 (56.76%)	1,033	1,748	570	141	
Widow/widower	1,798 (29.23%)	438	843	353	159	
Divorced	508 (8.26%)	159	239	85	27	
Separated	31 (0.50%)	9	18	0	4	
Unknown**	13 (0.21%)	2	6	2	3	
<b>Health Status</b>						<0.001
Poor	296 (4.8%)	65	110	75	46	
Not so good	3,011 (41.9%)	868	1,424	527	192	
Good	2,559 (41.60%)	731	1,332	396	100	
Very good	159 (2.58%)	38	83	34	4	
Unknown**	125 (2.1%)	24	68	27	8	
<b>Motor ability Impairment</b>						<0.001
Not impairment	1,642 (26.7%)	519	873	204	46	
Slight	2,037 (33.1%)	676	1,005	525	278	
Moderate	1,196 (19.4%)	332	525	271	68	
Severe	721 (11.7%)	161	278	165	117	
Unknown**	556 (9.0%)	38	336	133	49	
<b>Jointpain in last 12 months</b>						0.31
No	3,214 (52.24%)	891	1,611	529	183	
Yes	2,758 (44.83%)	792	1,325	491	150	
Unknown**	180 (2.93%)	43	81	39	17	

<b>Musculoskeletal Pain in the last year</b>						<0.001
No	1,567 (25.47%)	437	788	252	89	
Yes	3,246 (52.76%)	928	1,615	558	145	
<i>Unknown</i> **	1,339 (21.77%)	361	614	248	116	
<b>Feel Depressed</b>						<0.001
No	3,925(63.80%)	1,200	1,940	613	172	
A little	1,384(22.50%)	355	685	248	96	
A good amount	243 (3.95%)	49	103	63	28	
Very much	60 (0.98%)	14	25	11	10	
<i>Unknown</i> **	540 (8.78%)	108	264	124	44	

Data are presented as number of participants (column percentage) or mean  $\pm$  standard deviation.  
 \*Comparisons between categories in covariates and degree of VI; p-values reported using Pearson chi square tests for categorical covariates or ANOVA for continuous covariates. \*\* Unknown – number of missing values.

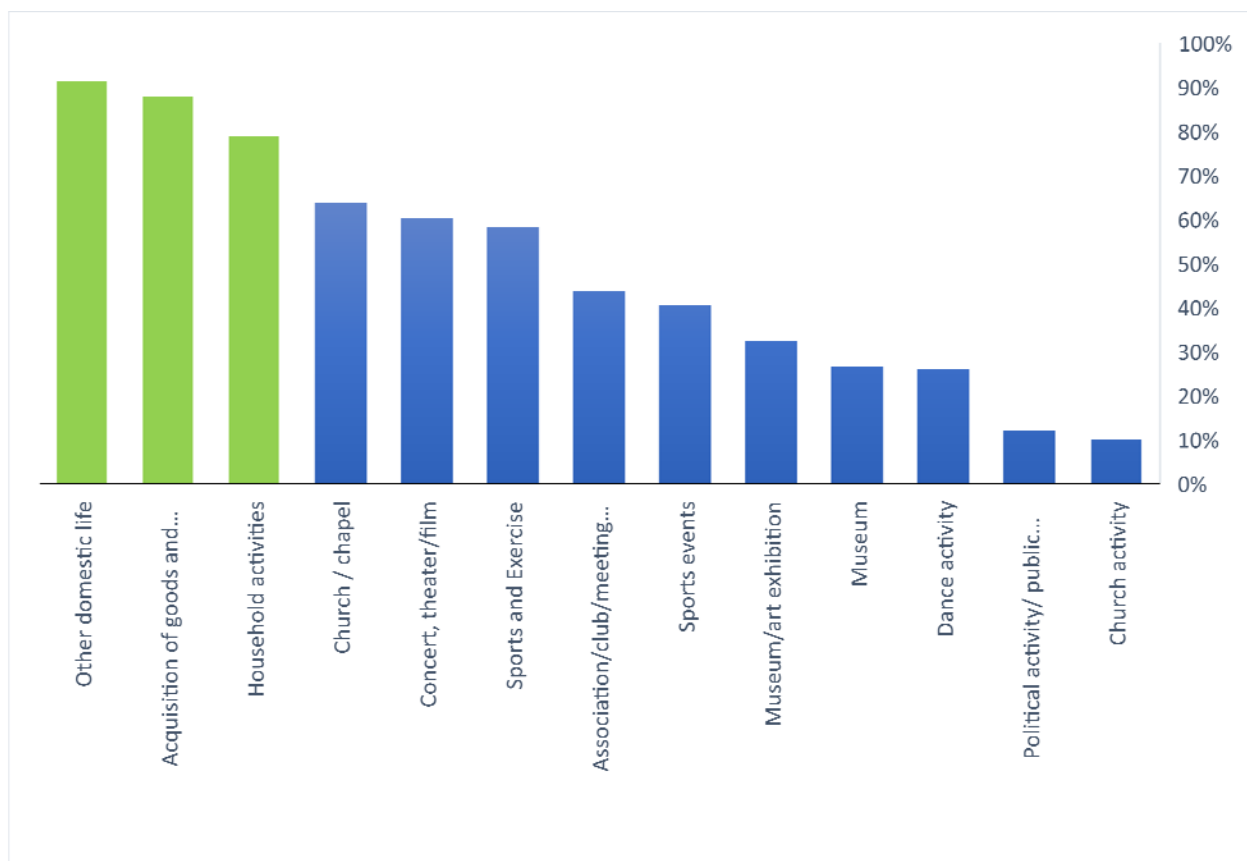
**Table 2.** Distribution of responses for the domains of participation, stratified by vision impairment.

Domain of participation	Value n (%)	Vision impairment				P-value*
• <b>Domestic Life</b>		<b>Not impaired n=1,726 (28%)</b>	<b>Slightly n=3,017(49.0%)</b>	<b>Moderate n=1,059(17.2%)</b>	<b>Severe n=350 (5.7%)</b>	
Acquisition of goods and Services						<0.001
Yes	5,399(87.76%)	1,577	2,687	902	233	
No	752(12.24%)	149	330	157	117	
Household task						<0.001
Yes	4,852(78.95%)	1,391	2,435	811	220	
No	1,292(21.05)	335	582	248	130	
Other domestic life						<0.001
Yes	5,617(91.30%)	1610	2,801	943	263	
No	535 (8.70%)	116	216	116	87	
• <b>Community social and Civic Life</b>	Value n (%)	<b>Not impaired n=1,726 (28%)</b>	<b>Slightly n=3,017(49.0%)</b>	<b>Moderate n=1,059(17.2%)</b>	<b>Severe n=350 (5.7%)</b>	<b>P-value*</b>
<b>Community life</b>						<0.001
An association/club meeting /activity						<0.001
Yes	2,029(43.55%)	628	1,016	315	70	
never	2,630(56.45%)	709	1,307	449	165	
<b>Recreation and leisure</b>						
sports or exercise						<0.001
Yes	2,720(58.31%)	817	1,376	445	82	
Never	1,945(41.69%)	522	940	331	152	
A sport events						<0.001
Yes	1,882(40.59%)	847	1,448	450	102	
Never	2,755(59.41%)	501	914	330	133	
Museum						0.07
Yes	1,220(26.42%)	383	598	187	52	
Never	3,397(73.58%)	952	1,693	570	182	
Concert, theatre/film						<0.001
Yes	2,842(60.25%)	847	1,448	450	102	
Never	1,878(39.75%)	501	914	330	133	
Museum/art exhibition						<0.001
Yes						
Never	1,483(32.27%)	473	755	215	40	

Dance activity	3,112(67.73)	840	1,540	539	193	<i>&lt;0.001</i>
Yes						
Never	1,187(26.04%) 3,371(73.96%)	376 946	596 1,659	188 562	27 204	
<b>Religion and spirituality</b>						
Church activity						<i>0.275</i>
Yes	451(9.92%)	138	232	60	21	
Never	4,095(90.08%)	1,182	2,017	683	213	
Church/ chapel						<i>&lt;0.001</i>
Yes	2,989(63.76%)	885	1,517	473	114	
Never	1,699(36.24%)	453	829	298	119	
<b>Political Life and Citizenship</b>						
Political activity/public debate						<i>0.004</i>
Yes	551(11.93%)	189	258	88	16	
Never	4,069(88.07%)	1,146	2,034	672	217	

Data are presented as number of subjects (column percentage). \*Comparisons between domains of participation and degree of VI; p-values reported using Pearson chi-square tests for categorical covariates.

Figure 4 below is presented for ease of seeing how many of the participants participated in different areas of life for the participation domains studied (Domestic life and Community, social and civic life). As can be seen in the figure, participants reported participating more in domestic life represented in green bars, than community, social and civic life represented in blue bars.



**Figure 4.** Positive responses in percentages to performance participation in domestic life and community, social and civic life. Green bars represent the domestic life domain. Blue bars represent the community, social and civic life domain.

#### 4.2 Association between the degree of VI and participation in domestic life

We evaluated the association between the degree of VI and domestic life. Table (3) shows the association with domestic life following a crude and adjusted logistic regression analysis.

In the crude model, a high odds ratio (OR) was observed in Severe VI participants (2.78), indicating a 2.78-fold risk of not participating or participating less in domestic life (OR 2.78, 95% CI 2.18 to 3.54) compared with not impaired participants. The result showed that severe VI has significant associations in participating less in domestic life. See table (3). The risk of not participating in domestic life reduces with an improvement in VI from moderate (OR 1.33 95%CI 1-11 to 1.59) to slight VI (OR 1.02 95%CI 0.88 to 1.18).

After adjusting for the potential confounders age, sex, education, health status, musculoskeletal pain, motor ability impairment, joint pain (table 3), this risk remained statistically significant for Severe VI (OR 1.62, 95% CI 1.18 to 2.22), though attenuated.



However, the associations for moderate VI (OR 1.03, 95% CI 0.83 to 1.28) and slight VI (1.04 95%CI 0.88 to 1.24) were not statistically significant.

**Table 3.** Crude model / Adjusted model for the association between degree of VI and participation in domestic life.

Domestic life						
Degree of Vision impairment	n	Number of no participation	CRUDE		ADJUSTED	
			P-value	OR (95%CI)	P-value	OR (95%CI)
Not impaired	1,726	344	1.00	ref	1.00	ref
Slightly impaired	3,017	610	0.81	1.02 (0.88 – 1.18)	0.62	1.04 (0.88 – 1.24)
Moderate	1,059	263	<0.001	1.33 (1.11 - 1.59)	0.75	1.03 (0.83 – 1.28)
Severe	350	143	<0.001	2.78 (2.18 – 3.54)	<0.001	1.62 (1.18 – 2.22)
Total	6,152					

Ref: reference group; \*OR: Odds ratio; CI: confidence interval. P-value = < 0.05. *Adjusted for age, sex, education, health status, joint pain, musculoskeletal pain, motor ability impairment.*

### 4.3 Association between the degree of VI and community, social and civic life

We evaluated the association between the degree of VI and participation in community, social and civic life using logistic regression, see Table (4).

In the crude model, a 0.58 odds ratio was found in people with severe VI (OR 0.58, 95% CI 0.45 to 0.74) indicating a 42% reduced risk of not participating in the community, social and civic life compared with not impaired participants. The risk of not participating in community, social and civic life also reduced in moderately impaired (OR 0.76 95%CI 0.64 to 0.9) and slight impairment participants (OR 0.93 95% CI 0.83 to 1.10).

However, after adjusting for confounding variables age, sex, education, health status, musculoskeletal pain, motor ability impairment, joint pain Table 4, Severe VI showed a OR 1.37 with 95% CI of 0.89 to 2.12, but this was not statistically significant, see table 4. The associations for the other VI groups were not statistically significant either.

**Table 4.** Crude model /adjusted Model for the association between degree of VI and participation in community, social and civic life.

<b>Community, Social and Civic Life</b>						
<b>Independent Variable</b>	<b>n</b>	<b>Number of no participation</b>	<b>CRUDE</b>		<b>Adjusted</b>	
<b>Degree of VI</b>			<i>P-Value</i>	<b>OR*(95%CI)</b>	<i>P-Value</i>	<b>OR*(95%CI)</b>
<b>Not impaired</b>	1,726	1,354	1.00	<i>ref</i>	1.00	<i>ref</i>
<b>Slightly impaired</b>	3,017	2,344	0.55 1.10)	0.93(0.83 to	0.37	0.90 (0.71 to 1.14)
<b>Moderate</b>	1,059	779	<0.001	0.76 (0.64 to 0.91)	0.22	0.83 (0.62 to 1.12)
<b>Severe</b>	350	237	<0.001	0.58 (0.45 to 0.74)	0.15	1.37 (0.89 to 2.12)
<b>Total</b>	6,152					

\*OR: Odds ratio; CI: confidence interval. P-value = < 0.05. Adjusted for age, sex, education, health status, joint pain, musculoskeletal pain, motor ability impairment. Ref: reference group

## **5.0 DISCUSSION**

### **5.1 Main findings**

In the current study, we investigated the association between the degree of VI and participation in older adults. Our focus on participation was in the domains of domestic life and of community, social and civic life, as described above. This study was done with a cross sectional sample of 6,152 participants aged 70 years or older, and based on the biopsychosocial model of the World Health Organization's international classification of functioning, disability, and health (ICF).

The results of our study revealed that older adults with VI participate in domestic life and community, social and civic life, that is to say, that they are "involved in life situation" as defined by ICF. However, the degree of VI was associated with a reduction in the level of participation in domestic life, with participation decreasing with the severity of vision impairment. Our results showed that participants with a severe VI have high risk of participating less in the domains of domestic life, however, the degree of VI has no effect on community, social and civic life compared to those that are not impaired. These associations are not significant after adjusting for confounders.

In a detailed description of participation in different areas of life and tasks, we found that the majority of our study population reported participating in household activities, acquisition of goods and services, and other domestic life activities such as bathing, dressing, and toileting. However, with respect to responses to participation in community, social and civic life, there was a reduction in participation compared to domestic life. The majority of participants reported not participating in political activities (88.07%), church activities (90.05%), dance activities (73.96%), arts and exhibitions (67.73%), sports events (59.41%), and organization activities (56.45%). This is perhaps not surprising following the likelihood of older adults, and especially those with vision loss, to have increased problems with their mobility (Jones et al., 2010). Nevertheless, 58.1% of our study sample reported that they participated in sports and exercises, 60.25% that they went to concerts, the theatre or film, and 63.73% that they participated in church/chapel activities.

Our study aims to collect more knowledge that can help to promote health and quality of life as well as active aging of older adults, for example through better policymaking. Many studies have shown the importance of environmental modification as well as the health

benefits of continuous participation in everyday life activities to health, aging, and quality of life. It is pertinent that policymakers, government, and also the general public are aware of participation outcomes among the older adults with VI and design better strategies geared at encouraging participation in this group, with consideration of the severity of their VI, ranging from not-impaired to slightly, moderate, and severely impaired. The current study has shown more understanding on the influence of severity of VI on participation. This information highlights possible targets in creating facilitators for promoting participation in vision impaired older adults which will encourage their participation, thereby helping to improve their health, well-being, and quality of life.

In future studies, a larger sample size with more equal distribution among the degrees of vision impairment should be used to replicate this study and determine the reason for low participation in community, social and civic life, as well as the determinants of why VI severity affects participation in domestic life but not community, social and civic life. Although age, family, as well as socioeconomic status of families have been shown to have much influence on participation (Law, 2002 pg 644), which could be one reason. Another study by Vik et al. (2007) also showed that being content as well as trying not to be a burden to families and society is common among the elderly who participated in their study, and this could also be a reason for reduced response to performance of participation in community, social and civic life. Future studies should also develop and use a more standardized approach and specifically designed questionnaire or measure to generate data about participation based on ICF recommendation. This would help generate a more in-depth understanding of the association between the degree of VI and participation. Furthermore, VI information should be received from health institutions rather than being self-reported.

## **5.2 Comparison with previous studies**

Few previous studies have evaluated specifically whether the degree of VI has an association with participation, and none have done so in a Norwegian context. In accordance with previous studies (Alma et al., 2010b; Desrosiers et al., 2009b), the results of the current study showed that older people with VI do participate in society. Our findings are also consistent with an earlier systematic review that investigated the association between VI and social participation in community-dwelling adults, which found evidence that VI is associated with reduced social participation (Shah et al., 2020). However, the results of the present study

contradict Alma et al. (2010b) who showed that severity, duration, and primary cause of VI does not influence participation. This is also in accordance with Desrosiers et al. (2009b) who found that visual acuity was not associated with participation. However, we did not investigate the duration and primary cause of vision impairment, because we did not have data on this.

However, our study did not support earlier findings that the severity of VI does not have effects on participation. The wide Confidence interval implies an inadequate sample size in the present study. But our result is consistent with other investigations like Crews et al. (2017) who found that poorer quality of life is strongly associated with self-reported severity in VI, in their study of the association of health-related quality of life (HRQL) with the severity of VI among people aged 40-64 years. In the same study, the younger cohort with moderate/severe VI showed a higher prevalence of life dissatisfaction than in older population. Also, older people who have little to moderately severe difficulty seeing showed a higher prevalence of disability and fair/poor self-reported health (Crews et al., 2017). The current study is also consistent with an earlier study that investigated unilateral and bilateral VI and its severity on health-related quality of life (QOL) in latin American people 40 years and older, which found that there is an association between severity of VI and vision related dependency and poorer vision related mental health (Varma et al., 2006).

Findings in the current study also suggest that although older adults with VI experience reduction in participation in domestic life depending on severity of VI, they find more relevance to domestic life participation than community, social and civic life. This is following their more positive responses to the performance of participation in domestic life compared to community, social and civic life, as shown above in Figure 3. However, certain aspects of community, social and civic life are of importance to them, such as sports and exercises, which stands in contrast to Alma et al. (2010a) who found that vision-impaired older people typically participate less in household activities and sports activities.

### **5.3 Strengths**

To the best of our knowledge, this cross-sectional study is the first to use a large study sample (n=6152) to investigate the association between the degree of VI and participation of older adults in multiple domains, using ICF's biopsychosocial model. Furthermore, HUNT has a

wide range of socio-demographic and lifestyle variables as part of their questionnaires and assessments, allowing us to include important confounders for the association between the degree of visual impairment and participation.

## **5.4 Limitations**

Our study would not be complete without pointing out several limitations related to it. Concerning the outcome and exposure measures, information about participation and VI was collected from available data in the HUNT population survey, not from validated questionnaires designed specifically for this purpose, although there is not yet a consensus on how to measure participation (Heinemann et al., 2010). VI information was assessed based on self-reports rather than a standard way of measuring VI, which potentially may have led to bias in the information given by the participants. Classifying missing data as “unknown” in the baseline characteristics could have resulted in additional confounding. In addition, we did not have equal sample sizes for those that answered the questions of VI between the not impaired to severe impairment. Especially severe impairment had a small sample size compared to the other degrees of vision impairment, which may make the results for this category less reliable. Finally, the current study is cross sectional, which allows for the identification of associated factors but without being able to ascertain a cause-and-effect relationship.

## **6.0 Conclusion**

Overall, this is the first cross sectional study to evaluate specifically the association between the degree of VI and participation in older adults using a Norwegian dataset. This study has shown that the degree or severity of VI was associated with an increased risk of participating less in domestic life, but has no influence on community, social and civic life. Understanding the participation of older adults based on the degree or severity VI is an important step towards the promotion of health, wellbeing, and quality of life in older adults with VI.

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