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Older People Needing All-Round Care in Health Facilities (Bedridden Older Residents) Have Higher Immunity than Community-Dwelling People Becoming Independent

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Abstract: *A relationship between physical activity and immunity has been reported previously; however, the amount of exercise has not been clarified. The efficiency of the immune system declines with age; thus, older people are less resistant to pathogenic microorganisms. The role of mucosal immunity in the defense against pathogens is well established. However, there is limited research on the relationship between salivary secretory immunoglobulin A (SIgA) concentration, activities of daily living (ADL), the amount of exercise, and cognitive function, particularly among geriatric residents staying long-term in health care facilities and community-dwelling older people who are becoming independent in ADL. We aimed to investigate the association between SIgA levels and ADL in older adults with different levels of care dependency. The cognitive functions and SIgA concentrations of 14 bedridden older residents needing all-round care in a long-term health care facility were compared with those of 9 community-dwelling older adults becoming independent in ADL in Japan. The bedridden older residents' group had lower Mini-Mental State Examination scores indicative of moderate cognitive impairment ($p < 0.001$), and significantly higher SIgA concentrations ($p < 0.01$). Enhanced dedicated care of mobile or partially mobile geriatric residents may be instrumental in infection prophylaxis.*
Keywords: *Salivary secretory immunoglobulin A (SIgA), Bedridden older residents, Community-dwelling older people becoming independent, Cognitive function*

1. Introduction

There is a relationship between physical activity and immunity [1-4], but the amount of exercise remains unclear. In addition, the efficiency of the immune system declines with age, making older individuals less resistant to infections of pathogenic microorganisms. The worldwide increase in the aging population poses healthcare challenges. Older age is associated with a higher burden of chronic diseases [5]. Previous studies have correlated aging with lower cognitive ability and dementia [6,7]. Additionally, the presence of comorbid conditions in the geriatric population increases their vulnerability to acute illnesses, such as infections [8]. Therefore, protective, preventive, and remedial factors that can counteract or delay disease manifestation must be explored. Increased physical activity among older adults decreases the risk of cognitive decline and infection [9,10]. Moderately active individuals were less susceptible to infectious diseases than those who were inactive [11,12].

In response to these findings, there has been a growing interest in the effects of exercise on mucosal immunity, particularly in terms of concentrations of secretory immunoglobulin A (SIgA), the major antibody in mucosal secretions, such as in the salivary glands [13-15]. SIgA is secreted by B cells surrounding the salivary glands [16]. Salivary SIgA levels have been linked to physical activity, which is measured as the weekly amount of time spent in sports [17]. Therefore, physical activity may effectively prevent infections by enhancing salivary SIgA levels. Geriatric residents needing all-round care in long-term healthcare facilities may demonstrate a trend of decreased activity, and increased risk of infection due to communal living. However, older people may be independent in their activities of daily living (ADL), and

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those residing in an area may be able to perform their activities by themselves. However, only a few studies have evaluated the association between SIgA and ADL within this population. Investigating the potential of physical activity to enhance SIgA secretion could underscore the importance of maintaining mobility and activity levels for overall health, supporting evidence-based strategies for infection prevention and health maintenance in older adults. Therefore, we aimed to investigate the association between mucosal immunity and mobility, as indicated by SIgA secretion, and the relationship between ADL among bedridden older residents needing all-round care in a long-term health care facility and community-dwelling older people becoming independent in ADL.

2. Materials and Methods

Participants were selected from among bedridden older residents needing all-round care in a long-term health care facility that provided medical and nursing care and from among community-dwelling older adults becoming independent in ADL, who used a day service. The pool of eligible participants comprised 14 residents and 9 community-dwelling older adults aged ≥ 65 years who were at the facility from January to March 2019. Of these, 10 were excluded because of physician- diagnosed bronchiectasis, leaving a total of 23 participants (14 bedridden older residents of a long-term health care facility and 9 community-dwelling older people).

2.1. Data on physical aspects and cognitive function

The age, height, weight, and body mass indices of each participant were noted. Cognitive function was evaluated using the Mini-Mental State Examination (MMSE). Scores ≥ 24 indicate uncompromised cognitive function, whereas scores ≤ 10 indicate severe cognitive impairment. The reliability and validity of this standard were inspected previously [18].

2.2. Saliva collection and SIgA concentration measurement

Saliva was collected between January and March 2019 using Sarivetee TM (Salimetrics, Carlsbad, CA, USA). Data were collected between 9:00 am and 11:00 am, following breakfast and subsequent oral care. The time required for saliva collection was measured, and the SIgA concentration was determined from the samples using a Salimetrics® SIgA Indirect Enzyme Immunoassay Kit.

2.3. Calculation of salivation speed

Higher salivation speeds result in increased saliva in the oral cavity. As the concentration of salivary SIgA decreases with increasing saliva, SIgA concentrations are low at high salivation speeds. Salivation speed (mL/min) was calculated based on the time required to collect a specified amount of saliva.

2.4. SIgA secretion speed

As SIgA concentrations are affected by the quantity of saliva secreted, the SIgA secretion speed was computed as the salivation speed multiplied by the SIgA concentration. This value was used as an index of SIgA production. SIgA secretion levels were considered high when the SIgA secretion rate was high.

2.5. Classification of ADL groups

Participants were divided into two groups according to their ADL in the long-term health care facility that provided medical and nursing care and local older residents who were capable of walking. The bedridden group comprised 14 participants staying in the long-term health care facility; and 9 community-dwelling older adults, who were confined to their beds except during meals and who required assistance for all ADL.

2.6. Data analysis

Multiple comparisons were performed using the Wilcoxon rank sum test to compare mean age, height, weight, BMI, MMSE scores, salivation speed, SIgA concentration, and SIgA secretion speed among the two groups (the bedridden group and the community-dwelling older people group). SPSS Statistics for Windows (version 29.0; IBM Corp., Armonk, USA), was used for all statistical analyses, with the significance level set at 0.05.

2.7. Ethical considerations

Written informed consent was obtained from all the participants. The study was approved by the Institutional Review Board of JCHO Saga Central Hospital and the International University of Health and Welfare and was conducted according to the principles set out in the Declaration of Helsinki.

3. Results

The sample population comprised more women than men. Age and weight were roughly equivalent between the two groups (see Table 1). The average MMSE scores of the entire sample and the bedridden older residents and community-dwelling older adults fell within the moderate impairment range. The scores of the bedridden older residents were in the severely impaired range and were significantly lower than those of the community-dwelling older adults ($p < 0.001$ for both comparisons).

Table 1. Demographics in this study

	Participants in this study		
Characteristics	All participants (n=23)	Bedridden older residents† (n=14)	Community dwelling older people†† (n=9)
Sex (n) (M/F)	8/15	3/11	5/4
Age (*years*) (Range 69-101)	86.3 ± 8.4	88.6 ± 7.6	78.1 ± 6.2
Weight (*kg*) (Range 34.3-69.9)	47.6 ± 8.1	46.5 ± 8.4	55.6 ± 9.5 ***
MMSE (*score*) (Range 0-24)	10.0 ± 8.5	3.8 ± 3.2	19.7 ± 2.7 **
SIgA concentration (*μg/mL*) (Range 152.2-1824.7)	568.6 ± 410.0	748.5 ± 440.4	328.9 ± 201.0 *
SIgA secretion speed (*μg/min*) (Range 0.33-454.6)	78.0 ± 100.4	110.4 ± 121.5	35.4 ± 32.4
Disease (n)			
Cerebrovascular	14	13	1
Cardiovascular	13	9	4
Digestive disease	20	16	4
Kidney disease	7	6	1
Endocrine metabolic	9	7	2

†Bedridden older residents: needing all-round care in a long-term health care facility that provided medical and nursing.

††Community dwelling older people: becoming independent in ADL.

We compared the mean age, weight, MMSE score, salivation speed, SIgA concentration and SIgA secretion speed in the groups (Wilcoxon rank sum test) . ***p<.001 **p<.01 *p<.05

The bedridden older residents also had significantly higher SIgA concentrations in the saliva ($p < 0.01$) and higher SIgA secretion speeds ($p < 0.05$) as compared to those in the community-dwelling older people. There were no differences in the salivation speed between the two groups.

The mental conditions of the participants were not associated with salivation speed, SIgA concentration, and SIgA secretion speed. However, our data suggested significant negative correlations between MMSE scores and SIgA concentration ($r = -0.58$, $p < 0.01$) (Figure 1) and between MMSE scores and SIgA secretion speed ($r = -0.36$, $p < 0.05$) (Figure 2).

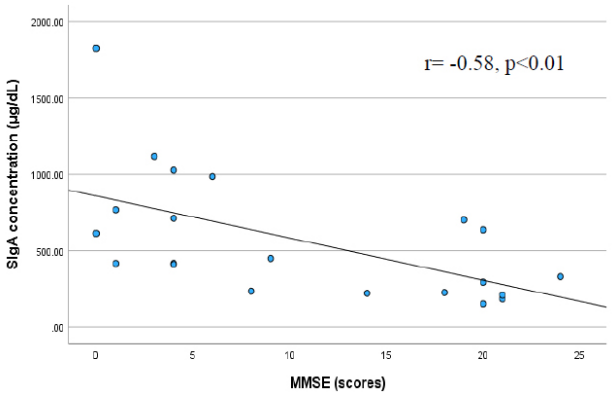

Figure 1. Relationships between MMSE scores and SIgA concentration (μg/mL)

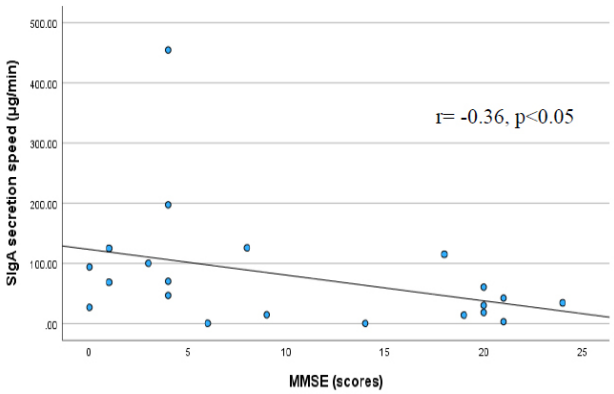

Figure 2. Relationships between MMSE scores and SIgA secretion speed (μg/mL)

4. Discussion

In this study, we aimed to explore the association between mucosal immunity and mobility. We investigated the association between SIgA concentration and ADL levels among older residents in a long-term health care facility.

The results of this study revealed significantly higher SIgA levels in bedridden residents than in community-dwelling older individuals. Additionally, the SIgA secretion rate in bedridden older residents was significantly higher than that in community-dwelling older adults. The results of this study revealed an inverse relationship between the indicators of mobility (ADL) and mucosal immunity (SIgA concentration) in geriatric residents in the long-term health care facility in Japan, as hypothesized. This was demonstrated by the significantly higher salivatory SIgA concentrations and secretion speeds in bedridden patients compared to those in older adults who could move using walking support or a wheelchair. Not-

ably, these results suggest that mobility is inversely correlated with SIgA levels.

Our findings are consistent with those of previous studies [19-21]. Taito et al. [22] reported that the SIgA secretion rate in hospitalized older patients is higher than that in patients using outpatient services. Furthermore, the SIgA level is higher among older inpatients than that among the non-hospitalized geriatric population [23]. The comparable setting of long-term healthcare facilities and that of constant medical and nursing care provided to bedridden residents may be implicated in their increased SIgA concentration and SIgA secretion speed.

In addition, our analyses revealed negative correlations between MMSE scores and SIgA concentration and secretion speed in bedridden residents, thereby associating cognitive impairment with high SIgA secretion. Kojima et al. found that a low MMSE score among older individuals was a risk factor for malnutrition and infection [24]. Dedicated care provided to bedridden older residents in long-term healthcare facilities may reduce the risk of malnutrition and infection. From a prophylactic perspective, it would be interesting to investigate the benefits of comparable dedicated care for ambulant and wheelchair-bound geriatric residents in long-term health care facilities.

In addition to the insights gained from the results, our results raise several possibilities for future research. SIgA, an antimicrobial found in secretions, is a useful stress evaluation index. Its levels decrease with chronic stress [25]. We postulate that the reduced SIgA concentrations among our ambulant participants could have resulted from increased stress in this population. Communal living can be a source of substantial emotional strain that negatively influences patient health [26]. Therefore, our study could be extended to objectively evaluate stress in this population. The average age of the bedridden older residents and community-dwelling older people differed by 10 years. Thus, the MMSE, SIgA concentration, and secretion speed may be affected by age. Another consideration would be regarding daily changes in SIgA concentration and its effect on associated factors, as the concentration of SIgA can fluctuate within an individual throughout the day [27,28]. Finally, similar studies with larger sample sizes and the quantification of functional abilities can improve generalization and minimize associated biases.

5. Conclusion

In this study, the bedridden residents had lower MMSE scores indicative of moderate cognitive impairment and significantly higher SIgA concentrations. Enhanced dedicated care to mobile or partially mobile geriatric residents may be instrumental in infection prophylaxis.

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