IJBSCHS
[Original article]

Biomedical Soft Computing and Human Sciences, Vol.25, No.1, pp.9-13

(Accepted in June 2020)

Elevated Salivary Secretory IgA (SIgA) in the Bedridden Geriatric Residents of a Long-Term Health Care Facility

Saigo BABA[1] and Hiroko KUKIHARA[2]

[1]*School of Nursing, Nishikyushu University*
[2]*Department of Nursing, Faculty of Medicine, Fukuoka University*

Abstract: *The role of mucosal immunity in the defense against pathogens is well established. However, there does not seem to be much research on the relationship between salivary secretory immunoglobulin A (SIgA), activities of daily living (ADL), and cognitive function, particularly among geriatric residents of long-term health care facilities. For this, the cognitive function and SIgA concentrations of 49 residents of such a long-term health care facility in Japan were evaluated across 3 mobility groups, namely, the walking (n = 11), wheelchair (n = 19), and bedridden groups (n = 19). Bedridden residents had lower mini-mental state than examination scores indicative of moderate cognitive impairment and significantly higher SIgA concentrations than the wheelchair and walking groups. We concluded that enhanced dedicated care of the mobile or partially mobile geriatric residents may be an instrument in infection prophylaxis.*
Keywords: *Activities of daily living (ADL), Bedridden geriatric residents, Cognitive function, Long-term health care facility, Salivary secretory immunoglobulin A (SIgA)*

1. Introduction

The worldwide increase in the aging population poses tough challenges to the health care community. Indeed, older age has been associated with increased burden of chronic diseases [1]. For example, previous studies have correlated aging with decreased cognitive ability and dementia [2,3]. Additionally, the presence of co-morbid conditions in the geriatric population increased their vulnerability to acute illnesses such as infections [4]. Therefore, it is imperative to explore protective, preventive, and remedial factors that can counter or delay disease manifestation. To this effect, increased physical activity among the elderly has been shown to decrease the risks of both cognitive decline and infection [5,6].

Concerning the latter, studies have demonstrated that moderately active individuals were less susceptible to infectious diseases than those who were inactive [7-9].

In response to such findings, there has been growing interest in the effects of exercise on mucosal immunity, particularly in terms of secretory immunoglobulin A (SIgA), the major antibody in mucosal secretions, such as in the salivary glands [10-12]. SIgA is secreted by B cells surrounding salivary glands [12]. Salivatory SIgA levels have been reportedly linked to physical activity, measured as the weekly amount of time spent in sports [13]. Therefore, the possibility exists that physical activity may effectively prevent infections by enhancing salivary SIgA levels. Geriatric residents in long-term health care facilities might demonstrate a trend of decreased activity, and 2 increased risk of infection due to communal living. However, there seems to be a scarcity of studies evaluating the association between SIgA and activities of daily living (ADL) within this population. Therefore, this study aimed to investigate the association between mucosal immunity and mobility as indicated by SIgA secretion and ADL among elderly residents in a long-term health care facility.

2. Materials and Methods

Participants were selected among geriatric residents of a long-term health care facility that provided medical

176-27 Ogi-mathi, Ogi-shi, Saga-ken 845-0001, Japan
Phone and Fax: +81-952-37-0273
e-mail: babasa@nisikyu-u.ac.jp

and nursing care in the Saga, Japan. The pool of eligible participants comprised 61 residents over the age of 65 years who were at the facility from January to March 2015. Of these, 12 were excluded due to physician-diagnosed bronchiectasis, thereby leaving a total of 49 participants.

2.1. Data on physical aspects and cognitive function

Age, height, weight, and body mass indices were noted for each participant. Cognitive function was evaluated through the widely used mini-mental state examination (MMSE). Scores of 24 and higher indicate uncompromised cognitive function, while scores of 10 and below indicate severe cognitive impairment. Reliability and validity of this standard have already been inspected [14].

2.2. Saliva collection and SIgA concentration measurement

Saliva was collected from January to March 2015 using a Sarivetee TM (Salimetrics®, Carlsbad, CA, USA). The collection was performed between 9:00 am and 11:00 am, following breakfast and subsequent oral care. Time required for saliva collection was measured and 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. Because the concentration of salivatory SIgA decreases with increased saliva, SIgA concentrations are low with high salivation speeds. For this study, salivation speed (mL/min) was calculated based on the time required to collect a specified amount of saliva.

2.4. SIgA secretion speed

Since SIgA concentrations are affected by the quantity of saliva secretion, SIgA secretion speed was computed as salivation speed multiplied by SIgA concentration. This was used as the index for SIgA production. SIgA secretion levels were considered to be high when SIgA secretion speed was high.

2.5. Classification of ADL groups

Participants were classified into three groups according to their ADL. The walking group (WG) included 11 participants who were ambulant and able to perform activities with a walker or a cane; the wheelchair group (WCG) involved 19 participants who could move and perform their activities with the assistance of a wheelchair; the bedridden group (BG) comprised the remaining 19, who were confined to their beds, except for meals, and required assistance for all ADLs.

2.6. Data analysis

Multiple comparisons were performed using the Tukey test to compare mean age, height, weight, BMI, MMSE scores, salivation speed, SIgA concentration and SIgA secretion speed among the three ADL groups (WG, WCG, and BG). SPSS Statistics for Windows, version 26.0 (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 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

As seen in Table 1, the sample comprised more females than males. Age, height, weight, and BMI were roughly equivalent among the 3 groups. Average MMSE scores of the entire sample and the WG and WCG fell in the moderate impairment range. Scores of the BG were in the severely impaired range and significantly lower than the other groups ($p < 0.0001$ for both comparisons).

The BG also had significantly higher SIgA concentration in the saliva ($p < 0.001$) and higher SIgA secretion speed ($p < 0.05$) as compared to the WG and WCG. There were no differences in salivation speed between groups.

No significant associations were noted between medical conditions of the participants and salivation speed, SIgA concentration, and SIgA secretion speed. However, our data suggested significant negative correlations between MMSE scores and SIgA concentration ($r = –0.618$, $p < .0001$) (Figure 1), and between MMSE scores and SIgA secretion speed ($r = –.383$, $p < .0001$) (Figure 2).

Table 1. Demographics of the 3 study groups

	Elderly residents of a long-term health care facility			
	All elderly residents	WG	WCG	BG
Characteristics	(*n* = 49)	(*n* = 11)	(*n* = 19)	(*n* = 19)
Sex (*n*)*(M/F)*	11/38	0/11	8/11	3/16
Age *(years)*	86.3 ± 8.4	83.6 ± 5.6	84.9 ± 10.7	89.0 ± 6.5
Height *(cm)*	149.3 ± 10	144.9 ± 5.6	152.5 ± 9.4	148.6 ± 11.7
Weight *(kg)*	47.6 ± 8.1	46.0 ± 4.6	50.6 ± 8.0	46.0 ± 9.0
BMI *(kg/m^2)*	21.4 ± 3.1	21.9 ± 2.1	21.8 ± 3.5	20.7 ± 3.0
MMSE *(score)*	18.1 ± 6.2	18.1 ± 6.2	17.6 ± 4.3	3.2 ± 5.0
Salivation speed *(ml/min)*	0.2 ± 0.2	0.2 ± 0.2	0.2 ± 0.2	0.2 ± 0.2
SIgA concentration *(μg/ml)*	192.9 ± 130.3	192.9 ± 130.3	221.3 ± 143.4	582.7 ± 421.0
SIgA secretion speed *(μg/min)*	14.1 ± 9.9	14.1 ± 9.9	43.5 ± 34.9	87.0 ± 104.5
Disease (*n*)				
Cerebrovascular	22	2	8	12
Cardiovascular	28	8	10	10
Digestive disease	10	0	4	6
Kidney disease	9	0	4	5
Endocrine metabolic	36	8	16	12

We compared the mean age, height, weight, BMI, MMSE score, salivation speed, SIgA concentration and SIgA secretion speed of each group (Multiple comparisons through Tukey) .
***p <.0001 **p <.001 *p <.05

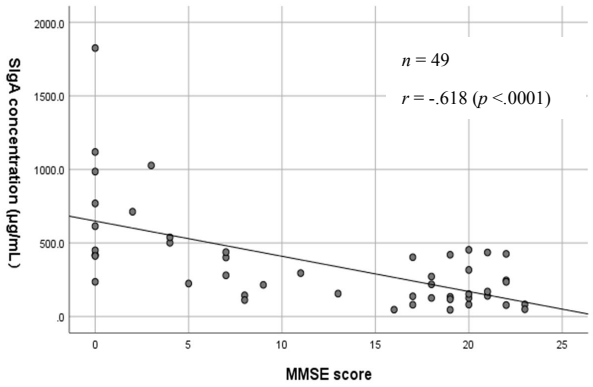

Figure 1. Correlations between MMSE scores and SIgA concentrations

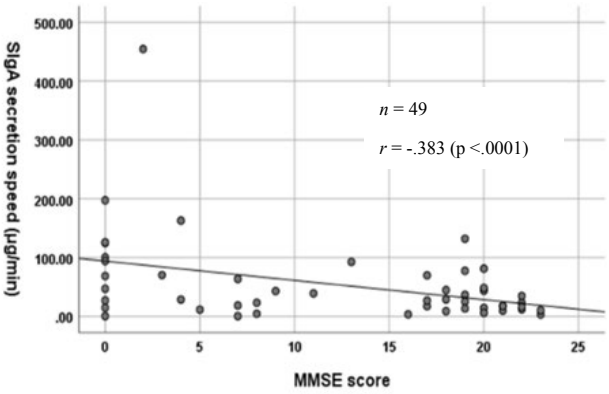

Figure 2. Correlations between MMSE scores and SIgA secretion speed

4. Conclusion

This study explored the link between mucosal immunity and mobility. Indeed, we investigated the association between SIgA concentrations and ADL levels among the elderly residents of a long-term health care facility.

The results of the study revealed significantly higher SIgA concentrations in the bedridden participants as compared to the walking and wheelchair groups. Additionally, SIgA secretion speed in the BG was significantly higher than in the WG. In evaluating geriatric residents of a long-term health care facility in Japan, the results of this study revealed an inverse relationship between indicators of mobility (ADL) and mucosal immunity (SIgA concentrations), as hypothesized. This was demonstrated through significantly higher salivatory SIgA concentrations and secretion speeds of bedridden patients compared to those who could move by means of walking supports or a wheelchair. Notably, these results together suggested that the level of mobility is inversely correlated to SIgA levels.

Our findings are consistent with previous studies [15-17]. In fact, Taito et al. [18] reported that SIgA secretion speed of hospitalized elderly patients was higher than those using outpatient services. Furthermore, SIgA was greater among the elderly inpatients as compared to the non-hospitalized geriatric population [19]. The comparable setting of long-term health care facilities and 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 also revealed negative correlations between MMSE scores and both SIgA concentration and secretion speed in the BG, thereby associating cognitive impairment to high SIgA secretion. Kojima et al. found that low MMSE score among elderly people is a risk factor for malnutrition and infection [20]. It is likely that the dedicated care provided to the bedridden geriatric residents of long-term health care facilities reduces the risks of malnutrition and infection. It would be interesting, from a prophylaxis perspective, to investigate the benefits of a comparably dedicated care to ambulant and wheelchair-bound geriatric residents of long-term health care facilities.

In addition to insights gained from the results, our data also raise a few possibilities to direct future research. SIgA, an antimicrobial in secretions, seems to be a useful stress evaluation index. Indeed, its levels de-

crease with chronic stress [21]. We postulated that the reduced SIgA concentrations among our ambulant participants could be the result of increased stress in this population. Communal living can be a source of substantial emotional strain that negatively influences the health of the patients [22]. Therefore, it is appealing to extend our study in the future to objectively evaluate stress in this population. Another consideration would be regarding daily changes in SIgA concentration and its effect on associated factors may be useful, since the concentration of SIgA can fluctuate within an individual across the daily [23,24]. Finally, similar studies involving a larger sample size and quantification of functional abilities can improve generalization and minimize associated biases.

References

[1] Yaffe, K., Barnes, D., Nevitt, M., Lui, L. Y. and Covinsky, K., A prospective study of physical activity and cognitive decline in elderly women: Women who walk, Archives of Internal Medicine, Vol.161, pp.1703-1708, 2001.

[2] Wang, H. X., Karp, A., Winblad, B. and Fratiglioni, L., Late-life engagement in social and leisure active ties is associated with a decreased risk of dementia: A longitudinal study from the Kungsholmen project, American Journal of Epidemiology, Vol.155, pp.1081-1087, 2002.

[3] Abbott, R. D., White, L. R., Ross, G. W., Masaki, K. H., Curb, J. D. and Petrovitch, H., Walking and dementia in physically capable elderly men, The Journal of the American Medical Association, Vol.292, pp.1447-1453, 2004.

[4] Shephard, R. J. and Shek, N. P., Exercise, aging and immune function, International Journal of Sports Medicine, Vol.16, pp.1-6, 1995.

[5] Weuve, J., Kang, J. H., Manson, J. E., Breteler, M. M., Ware, J. H. and Grodstein, F., Physical activity, including walking, and cognitive function in older women, The Journal of the American Medical Association, Vol.292, pp.1454-1461, 2004.

[6] Lautenschlager, N. T., Cox, K. L., Flicker, L., Foster, J. K., van Bockxmeer, F. M., Xiao, J., Greenop, K. R. and Almeida, O. P., Effect of physical activity on cognitive function in older adults at risk for Alzheimer disease: A randomized trial, The Journal of the American Medical Association, Vol.300, pp.1027-1037, 2008.

[7] Oliver, S. J., Laing, S. J., Wilson, S., Bilzon, J. L., Walters, R. and Walsh, N. P., Salivary immunoglobulin A response at rest and after exercise following a 48 h period of fluid and/or energy restriction, British Journal of Nutrition, Vol.97, pp.1109-1116, 2007.

[8] Neville, V., Gleeson, M. and Folland, J. P., Salivary IgA as a risk factor for upper respiratory infections in elite professional athletes, Medicine and Science in Sports and Exercise, Vol.40, pp.1228-1236, 2008.

[9] Sakamoto, Y., Ueki, S., Kasai, T., Takato, J., Shimanuki, H., Honda, H., Ito, T. and Haga, H., Effect of exercise, aging and functional capacity on acute secretory immunoglobulin A response in elderly people over 75 years of age, Geriatrics & Gerontology International, Vol.9, pp.81-88, 2009.

[10] Kostka, T., Berthouze, S. E., Lacour, J. and Bonnefoy, M., The symptomatology of upper respiratory tract infections and exercise in elderly people, Medicine and Science in Sports and Exercise, Vol.32, pp.46-51, 2000.

[11] Matthews, C. E., Ockene, I. S., Freedson, P. S., Rosal, M. C., Merriam, P. A. and Hebert, J. R., Moderate to vigorous physical activity and risk of upper-respiratory tract infection, Medicine and Science in Sports and Exercise, Vol.34, pp.1242-1248, 2002.

[12] Moreira, A., Bacurau, R. F. P., Napimoga, M. H., Arruda, A. F. S., Freitas, C. G., Drago, G. and Aoki, M. S., Salivary IL-21 and IgA responses to a competitive match in elite basketball players, Biology of Sport, Vol.30, pp.243-247, 2013.

[13] Nieman, D. C., Johansen, M. L., Lee, W. J. and Arabatzis, K., Infectious episodes in runners before and after the Los Angeles Marathon, The Journal of Sports Medicine and Physical Fitness, Vol.30, pp.316-328, 1990.

[14] Folstein, M. F., Folstein, S. E. and McHugh, P. R., "Mini-mental state": A practical method for grading the cognitive state of patients for the clinician, Journal of Psychiatric Research, Vol.12, pp.189-198, 1975.

[15] Shimizu, K., Kimura, F., Akimoto, T., Akama, T., Kuno, S. and Kono, I., Effect of free-living daily physical activity on salivary secretory IgA in elderly, Medicine and Science in Sports and Exercise, Vol.39, pp.593-598, 2007.

[16] Akimoto, T., Kumai, Y., Akama, T., Hayashi, E.,

Murakami, H., Soma, R., Kuno, S. and Kono, I., Effects of 12 months of exercise training on salivary secretory IgA levels in elderly subjects, British Journal of Sports Medicine, Vol.37, pp.76-79, 2003.

[17] Sawada, M., Inamizu, T., Taito, S., Sekikawa, K. and Kawaguchi, K., Variabilities of salivary secretory immunoglobulin A among elderly in long-term care facilities, Japanese Journal of Physical Fitness and Sports Medicine, Vol.57, pp.241-248, 2008.

[18] Taito, S., Sekikawa, S., Kawae, T., Takahashi, M., Matsubara, A. and Inamizu, T., Biological variations of salivary immunoglobulin A in the elderly, Journal of Analytical Bioscience, Vol.33, pp.167-172, 2010.

[19] Shibuya, Y., Nomura, H. and Ono, J., Study on the usability of saliva as laboratory examination sample, Bulletin of Kobe Tokiwa University, Vol.9, pp.103-112, 2016.

[20] Kojima, M., Kawase, F., Ochi, H., Suzuki, M., Natsume, A., Yamamoto, M., Tachibana, E. and Tsukahara, O., Mini mental state examination ≤ 10 is a risk factor for skeletal muscle mass reduction, Annual Report of Institute of Health and Nutrition, Nagoya University of Arts and Sciences, Vol.12, pp.37-44, 2018.

[21] Tsujita, S. and Morimoto, K., Secretory IgA in saliva can be a useful stress marker, Environmental Health and Preventive Medicine, Vol.4, pp.1-8, 1999.

[22] van den Brink, A. M., Gerritsen, D. L., Voshaar, R. C. and Koopmans, R. T., Residents with mental-physical multimorbidity living in long-term care facilities: Prevalence and characteristics. A systematic review, International Psychogeriatrics, Vol.25, pp.531-548, 2013.

[23] Bishop, N. C. and Gleeson, M., Acute and chronic effects of exercise on markers of mucosal immunity, Frontiers in Bioscience, Vol.14, pp.4444-4456, 2009.

[24] Corthésy, B., Role of secretory immunoglobulin A and secretory component in the protection of mucosal surfaces, Future Microbiology, Vol.5, pp.817-829, 2010.

Saigo BABA

He received the Ph.D. from Saga Medical University in 2017. He has been working as an associate professor at Nishikyushu University, School of Nursing. His present research interests include the exercise and immunology.

Hiroko KUKIHARA

She received the Ph.D. from Saga Medical University in 2014. She has been working as a professor at Fukuoka University, Department of Nursing. Her present research interests include the mindfulness and resilience.