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# Clinical characteristics of individuals stratified by the number of answered items on the 25-question Geriatric Locomotive Function Scale

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## ABSTRACT

The 25-question Geriatric Locomotive Function Scale (GLFS-25) is a tool to identify locomotive syndrome, however, this tool is associated with the problem of a low complete response rate. We conducted this cross-sectional study of 2,474 community-dwelling residents to investigate the clinical characteristics of individuals who are prone to provide incomplete responses to the GLFS-25 questionnaire. The participants were divided into the following four groups based on the number of the GLFS-25 items they answered: 0 (n=279), 1–21 (n=36), 22–24 (n=273), and 25 (n=1,886). We investigated clinical characteristics including age, sex, body mass index, health consciousness, housemate status, smoking and drinking habits, physical activity level, the presence of body pain, and comorbidities. To achieve the study objective, we focused on a comparison of the clinical characteristics between the group of participants who answered 22–24 items (target group) and 0 items (control group). The participants who answered 22–24 items were older, more likely to be health-conscious, more likely to live alone, less likely to have lower levels of physical activity, and were more likely to report neck pain, low back pain, shoulder pain, elbow pain, wrist pain, hip pain, knee pain, ankle pain, and ophthalmic disease than those who answered 0 items. Among the significant factors, the only factor that can be changed to improve the number of answered items on the GLFS-25 is health consciousness.

Keywords: locomotive syndrome, the 25-question Geriatric Locomotive Function Scale, response rate, answer, characteristic

Abbreviations:
GLFS-25: 25-question Geriatric Locomotive Function Scale
LS: locomotive syndrome
METs: metabolic equivalents



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## INTRODUCTION

In 2007, the Japanese Orthopaedic Association introduced the term "locomotive syndrome (LS)" to refer to conditions affecting the body's mobility-related functions due to musculoskeletal diseases such as lumbar canal stenosis and osteoarthritis.[1] In order to identify individuals with LS, they developed a tool called the 25-question Geriatric Locomotive Function Scale (GLFS-25).[2] The GLFS-25 is composed of 25 items that are ranked on a scale of 0 to 4 (Table 1): "none" (0 points), "mild" (1 point), "moderate" (2 points), "considerable" (3 points), and "severe" (4 points) impairment. These scores were then tallied to yield a total ranging from 0 to 100, with higher scores indicating a more pronounced degree of LS.[2-4] Based on the GLFS-25 total score, individuals were categorized into four groups: a score of ≤6 points was classified as non-LS; scores of 7–15 points were categorized as LS-1; scores of 16–23 points were classified as LS-2; and scores of ≥24 points were classified as LS-3. The estimated total number of individuals of 40–80 years of age with LS-2 or more is 6.5–7.5 million, and poses an urgent social issue.[5,6]

In contrast to the two-step and stand-up test,[3,4] the distinctive feature of the GLFS-25 is its simplicity, as it does not require the use of specialized measuring equipment. Instead, it can be administered using a pen and paper. Therefore, the GLFS-25 is the prevailing appraisal

**Table 1** GLFS-25 questionnaire items

| Questionnaire item |
|---|
| 1. Have you had any pain (including numbness) in your neck or upper limbs? |
| 2. Have you had any pain in your back, lower back or buttocks? |
| 3. Have you had any pain (including numbness) in your lower limbs? |
| 4. To what extent has it been painful to move your body in daily life? |
| 5. To what extent has it been difficult to get up from a bed or lie down? |
| 6. To what extent has it been difficult to stand up from a chair? |
| 7. To what extent has it been difficult to walk inside the house? |
| 8. To what extent has it been difficult to put on and take off a shirt? |
| 9. To what extent has it been difficult to put on and take off trousers and pants? |
| 10. To what extent has it been difficult to use the toilet? |
| 11. To what extent has it been difficult to wash your body in the bath? |
| 12. To what extent has it been difficult to go up and down the stairs? |
| 13. To what extent has it been difficult to walk briskly? |
| 14. To what extent has it been difficult to keep yourself neat? |
| 15. How far can you keep walking without rest? |
| 16. To what extent has it been difficult to go out to visit neighbors? |
| 17. To what extent has it been difficult to carry objects weighing 2 kg? |
| 18. To what extent has it been difficult to go out using public transportation? |
| 19. To what extent have simple tasks and housework been difficult? |
| 20. To what extent have load-bearing tasks and housework been difficult? |
| 21. To what extent has it been difficult to perform sports activities? |
| 22. Have you felt restricted from meeting your friends? |
| 23. Have you felt restricted from joining social activities? |
| 24. Have you ever felt anxious about falls in your house? |
| 25. Have you ever felt anxious about being unable to walk in the future? |

GLFS-25: 25-question Geriatric Locomotive Function Scale

mechanism for LS in both clinical practice and research domains.[1-9] Nevertheless, a significant constraint of the GLFS-25 persists in the form of a low complete response rate, which ranges from 50% to 81%.[7-9] This can potentially be attributed to the extensive number of question items and scales encompassed within the assessment.[7-9] To address this issue, healthcare professionals should understand the clinical characteristics of individuals who are prone to provide incomplete responses to the GLFS-25 questionnaire. A thorough investigation into the clinical characteristics of individuals who are prone to providing incomplete responses to the GLFS-25 questionnaire has not been conducted so far.

We conducted a cross-sectional study to investigate the clinical characteristics of individuals who are prone to provide incomplete responses to the GLFS-25 questionnaire.

## MATERIALS AND METHODS

*Study design*

This cross-sectional study accessed Japanese Orthopaedic Association (JOA)-Subsidized Science Project Research database, which contained clinical data of community-dwelling residents aged 40 years or over who were able to walk independently and who attended a 'basic health checkup' in Minami-Aizu Town, Fukushima Prefecture, Japan, in 2018. In 2018, the population aged 40 years or over in Minami-Aizu Town[10] numbered 11,092. Among them, 2,922 individuals participated in the checkup, and 2,474 provided written informed consent to participate in our study and were considered eligible for inclusion. This study was approved by our institutional ethics committee.

A questionnaire regarding the GLFS-25 and clinical characteristics was sent to the participants' residences prior to the basic health checkup. During this survey, health checkup assistants reviewed the questionnaire and attempted to complete any blank fields to the best of their abilities. If a participant declined or was unable to respond to the question, the corresponding space was left blank.

*GLFS-25*

The GLFS-25 consists of 25 items graded on a 5-point scale (Table 1) as follows[2-4]: no (0 points), mild (1 point), moderate (2 points), considerable (3 points), and severe (4 points) impairment, for a total possible score of 0–100.

*Clinical characteristics*

We investigated clinical characteristics, including age, sex, body mass index, health consciousness, housemate status, smoking and drinking habits, low levels of physical activity level, presence of body pain, and comorbidities. Regarding housemate status, we investigated whether the participant lived alone or not. Regarding smoking habits, we investigated whether the participant was a current smoker or not. Regarding drinking habits, we investigated whether or not the participant drank alcohol every day. Participants were categorized as health conscious if they answered "yes" to the question: "Are you planning to improve your lifestyle?" The physical activity level was estimated using the International Physical Activity Questionnaire short form (IPAQ-SF), which is a validated questionnaire, consisting of nine questions regarding the time spent engaged in vigorous- and moderate-intensity activities, walking, and sedentary activity in a typical week.[11] In this study, the sum of vigorous (8 metabolic equivalents [METs]), moderate (4 METs), and walking (3.3 METs) activities was calculated as MET-hours/week.[12] According to the IPAQ (2005) Guidelines,[11] the IPAQ-SF score was classified as categorical data; <10 MET-hours/week (low) and ≥10 MET-hours/week (middle or high). Presence of body pain was

investigated using a questionnaire on chronic musculoskeletal pain (ie, neck pain, low back pain, shoulder pain, elbow pain, wrist pain, hip pain, knee pain, and ankle pain) persisting for three months or longer.[13] Experienced public health nurses collected data on participants' comorbidities requiring hospital visits (ie, ophthalmic disease, cerebrovascular disease, cardiovascular disease, pulmonary disease, and renal disease).[14] We analyzed these comorbidities because they tended to be the most common ones observed in clinical practice.[12-16]

*Statistical analyses*

The normality of the continuous data distribution was assessed using the Shapiro-Wilk test. A $p$-value of <0.050 indicated that the distribution was not normal. For preliminary comparisons involving multiple groups, a one-way ANOVA was applied to continuous variables that showed a normal distribution. The Kruskal-Wallis test was used for continuous variables that did not exhibit a normal distribution. Fisher's exact test was used for categorical variables. In these tests, $p$-values of <0.050 were considered to indicate statistical significance. For subsequent pairwise comparisons performed as post-hoc tests, Student's $t$-test was used for continuous variables with a normal distribution. Dunn's test was used for continuous variables that did not have a normal distribution. Fisher's exact test was used for categorical variables. These tests were adjusted using Bonferroni correction, and $p$-values of <0.016 were considered to indicate statistical significance (calculated as 0.05, divided by 3). All statistical analyses were performed using JMP Pro (ver. 16, SAS Institute, Cary, NC, USA).

## RESULTS

The number of items answered on the GLFS-25 is shown in Fig. 1. When looking at the variables in a histogram, the distribution appeared to be a four-modal type of distribution. There-

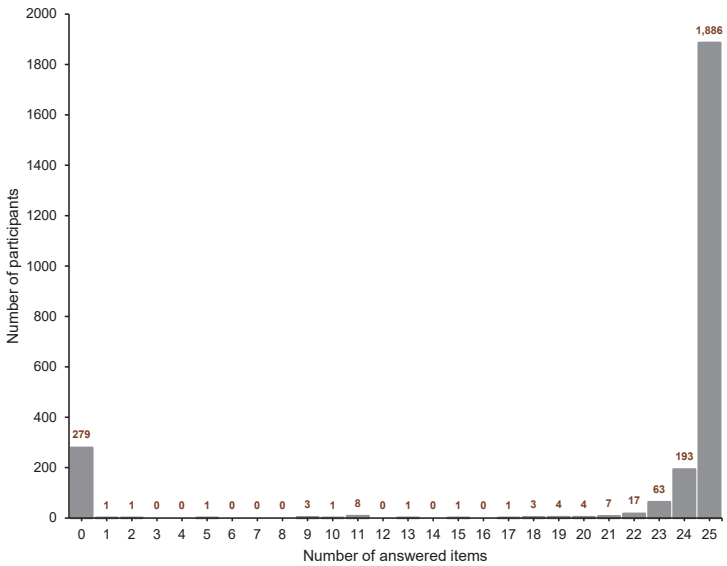


**Fig. 1** Distribution of the number of answered items of the GLFS-25
GLFS-25: 25-question Geriatric Locomotive Function Scale

fore, we divided the participants into four groups: number of answered items 0 (n=279), 1–21 (n=36), 22–24 (n=273), and 25 (n=1,886). We observed that 23.8% (n=588) of the participants did not provide complete answers to the GLFS-25 questionnaire. Notably, the number of answered items 1–21 was heterogeneous and small (<5% of total participants). As such, they could be ignored in this analysis. Therefore, we set the number of answered items to 0 (n=279), 22–24 (n=273), and 25 (n=1,886) as the target of the investigation. Furthermore, we set the group of participants who answered 22–24 items as the target group and 0 items as the control group. The characteristics of the participants who were excluded from this study are summarized in Table 2.

Table 3 summarizes a comparison of characteristics among participants stratified by the number of answered items on the GLFS-25. The participants who answered 22–24 items were older, more likely to be health-conscious, more likely to live alone, less likely to have lower levels of physical activity, and were more likely to report neck pain, low back pain, shoulder pain, elbow pain, wrist pain, hip pain, knee pain, ankle pain, and ophthalmic disease than those who answered 0 items.

**Table 2** Out of interest in the investigation (number of answered items 1–21)

| | (n=36) |
|---|---|
| Age, years | 78.0 (74.0–84.0) |
| Female, n (%) | 24 (66.7) |
| Body mass index, kg/m$^2$ | 23.7 ± 4.4 |
| Health-conscious, n (%) | 4 (11.1) |
| Living alone, n (%) | 8 (22.2) |
| Current smoker, n (%) | 2 (5.6) |
| Everyday alcohol consumption, n (%) | 6 (16.7) |
| Low levels of physical activity, n (%) | 25 (69.4) |
| Body pain, n (%) | |
| Neck pain | 1 (2.8) |
| Low back pain | 13 (36.1) |
| Shoulder pain | 6 (16.7) |
| Elbow pain | 2 (5.6) |
| Wrist pain | 3 (8.3) |
| Hip pain | 5 (13.9) |
| Knee pain | 12 (33.3) |
| Ankle pain | 6 (16.7) |
| Comorbidity, n (%) | |
| Ophthalmic disease | 11 (30.6) |
| Cerebrovascular disease | 1 (2.8) |
| Cardiovascular disease | 2 (5.6) |
| Pulmonary disease | 2 (5.6) |
| Renal disease | 0 (0) |

**Table 3** The comparison of characteristics among participants stratified by number of answered items of the GLFS-25

| | Number of answered items | | | *p* value |
|---|---|---|---|---|
| | 0 (n=279) | 22–24 (n=273) | 25 (n=1,886) | |
| Age, years | 72.0 (66.0–79.0) | 77.0 (71.0–81.0) [a] | 70.0 (65.0–77.0) [a, b] | <0.001 [c] |
| Female, n (%) | 165 (59.1) | 186 (68.1) | 1,022 (54.2) [b] | <0.001 [d] |
| Body mass index, kg/m$^2$ | 23.6 ± 3.1 | 23.5 ± 3.3 | 23.6 ± 3.2 | 0.839 [e] |
| Health-conscious, n (%) | 78 (28.0) | 105 (38.5) [a] | 713 (37.8) [a] | 0.005 [d] |
| Living alone, n (%) | 2 (0.7) | 54 (19.8) [a] | 261 (13.8) [a, b] | 0.001 [d] |
| Current smoker, n (%) | 29 (10.4) | 24 (8.8) | 192 (10.2) | 0.771 [d] |
| Everyday alcohol consumption, n (%) | 72 (25.8) | 56 (20.5) | 494 (26.2) | 0.128 [d] |
| Low levels of physical activity, n (%) | 276 (98.9) | 132 (48.4) [a] | 649 (34.4) [a, b] | <0.001 [d] |
| Body pain, n (%) | | | | |
| Neck pain | 1 (0.4) | 20 (7.3) [a] | 124 (6.6) [a] | 0.041 [d] |
| Low back pain | 2 (0.7) | 108 (39.6) [a] | 517 (27.4) [a, b] | <0.001 [d] |
| Shoulder pain | 1 (0.4) | 59 (21.6) [a] | 316 (16.8) [a] | <0.001 [d] |
| Elbow pain | 1 (0.4) | 14 (5.1) [a] | 102 (5.4) [a] | <0.001 [d] |
| Wrist pain | 1 (0.4) | 40 (14.7) [a] | 234 (12.4) [a] | <0.001 [d] |
| Hip pain | 0 (0) | 27 (9.9) [a] | 100 (5.3) [a, b] | <0.001 [d] |
| Knee pain | 1 (0.4) | 85 (31.1) [a] | 453 (24.0) [a, b] | <0.001 [d] |
| Ankle pain | 1 (0.4) | 47 (17.2) [a] | 171 (9.1) [a, b] | <0.001 [d] |
| Comorbidity, n (%) | | | | |
| Ophthalmic disease | 63 (22.6) | 95 (34.8) [a] | 433 (23.0) [b] | <0.001 [d] |
| Cerebrovascular disease | 8 (2.9) | 7 (3.6) | 40 (2.1) | 0.568 [d] |
| Cardiovascular disease | 18 (6.5) | 30 (11.0) | 157 (8.3) | 0.157 [d] |
| Pulmonary disease | 9 (3.2) | 10 (3.7) | 76 (4.0) | 0.855 [d] |
| Renal disease | 2 (0.7) | 7 (2.6) | 29 (1.5) | 0.239 [d] |

GLFS-25: 25-question Geriatric Locomotive Function Scale

[a] Significantly different ($p$<0.016) from the values in participants with number of answered item 0.

[b] Significantly different ($p$<0.016) from the values in participants with number of answered item 22–24.

[c] Values were presented as the median (interquartile range) and analyzed using the Kruskal–Wallis test (statistical significance was determined at $p$<0.050).

[d] Values were presented as the number (percentage) and analyzed using the Fisher's exact test (statistical significance was determined at $p$<0.050).

[e] Values were presented as the mean ± standard deviation and analyzed using the one-way ANOVA (statistical significance was determined at $p$<0.050).

## DISCUSSION

A low complete response rate (50–81%) remains a major limitation of the GLFS-25.[7-9] Therefore, the clinical characteristics of individuals classified according to the quantity of completed

items on the GLFS-25 questionnaire should be clarified. To the best of our knowledge, this is the first study to investigate this topic.

We found that 23.8% of participants did not provide complete answers to the GLFS-25. In previous reports, the incomplete response rate has been reported to range from 19% to 50%.[7-9] This difference in the incomplete response rate may be due to the use of different methods or environmental variations.[17-22] ; the response rate observed in surveys conducted while the elderly individuals were living at home was higher than the rate observed when the survey was conducted at a medical clinic. Furthermore, an online survey is not appropriate for the elderly. Thus, we conducted a pen-and-paper survey prior to a 'basic health checkup.' Although the questionnaire used in this study included many questions in addition to the GLFS-25, the health checkup assistants tried to fill in the blanks as much as possible. These simple strategies may have led to the relatively high complete response rate observed in our study compared to previous reports.

We found that the number of items answered in the GLFS-25 questionnaire was associated with a variety of factors, including age, sex, health consciousness, housemate status, physical activity level, and the presence of neck pain, low back pain, shoulder pain, elbow pain, wrist pain, hip pain, knee pain, ankle pain, and ophthalmic disease. Previous studies have shown that the number of items answered in other questionnaires was linked to factors such as age, sex, occupational class, income, work arrangement, comorbidities, region, ethnicity, survey length, and survey methodology (eg, pen-and-paper surveys [before and during the clinic visit] and online surveys).[17-22] Many of the examined items differed, but age and sex can be considered consistent.

We observed that individuals who exhibited low levels of physical activity were more likely to provide fewer answers to the GLFS-25 questionnaire. A previous study reported a link between low levels of physical activity and limited health awareness.[23] Thus, low levels of physical activity are likely to be associated with non-participation in musculoskeletal consultation and treatment (ie, health awareness).

Interestingly, the participants who answered 0 rarely reported any body pain. In other words, the presence of body pain may be a clinical characteristic of individuals who are likely to have more answers to the GLFS-25. The detailed causal relationship between body pain and the number of responses is unclear, and further research is required regarding this phenomenon in the future.

In our study, we found that health consciousness was one of the significant clinical characteristics between participants who answered 22–24 items and 0 items on the GLFS-25 questionnaire. This indicates a relationship between health consciousness and an increase in the number of responses to the GLFS-25, which is a modifiable factor. Therefore, it is important to take steps to increase public awareness of health issues. One way to do this is through LS awareness campaigns, which can help to incrementally increase the response rate.

Focusing on the participants who completed the GLFS-25 questionnaire, our results reveal a selection bias in studies involving individuals who responded to the GLFS-25. That is individuals with the following characteristics are likely to be included from such studies: younger age, male sex, living with someone, less likely to have lower levels of physical activity, and the absence of low back pain, hip pain, knee pain, or ankle pain, and the presence of ophthalmic disease. Accordingly, the results of past and future studies on the GLFS-25 should be interpreted with caution. For example, epidemiological studies on the age distribution of individuals who respond to the GLFS-25 will tend to report a higher proportion of findings from younger subjects than from older subjects.

The present study has some limitations. First, we did not assess respondent factors (eg, cognitive status and educational level) because of a lack of data. It seems difficult to investigate these factors in all participants during a 'basic health checkup.' Further investigations are required

to determine these points. Second, the severity, duration, and treatment of comorbidities and their influence on functional mobility were not accurately assessed owing to a lack of data. Despite these limitations, our findings provide the first statistical evidence regarding the clinical characteristics of individuals stratified by the number of answered items on the GLFS-25 in the general population using a pen-and-paper survey. Third, despite the diligent efforts of health checkup assistants to complete as many unanswered questions in the GLFS-25 questionnaire as possible, a considerable number remained incomplete. There are various reasons for this, such as patient refusal, non-response, or insufficient time to gather information. This qualitative issue presents a challenge in conducting clinical research during health checkups, and merits consideration as a future concern.

## CONCLUSION

We clarified the clinical characteristics of individuals who are prone to provide incomplete responses to the GLFS-25 questionnaire. The participants who answered 22–24 items were older, more likely to be health-conscious, more likely to live alone, less likely to have lower levels of physical activity, and were more likely to report neck pain, low back pain, shoulder pain, elbow pain, wrist pain, hip pain, knee pain, ankle pain, and ophthalmic disease than those who answered 0 items. Health consciousness emerged as the sole modifiable factor to improve the number of answered items on the GLFS-25.

## IRB APPROVAL

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional review board of Fukushima Medical University School of Medicine (No. 2907) and with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

## AUTHOR CONTRIBUTIONS

Takaomi Kobayashi and Tadatsugu Morimoto equally contributed to this work (wrote and prepared the manuscript). All authors have read, reviewed, and approved the article.

## CONFLICT OF INTEREST

None.

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