# Longitudinal study to determine whether maintaining limb and trunk muscle strength, especially back muscle strength, is useful in preventing back pain deterioration, maintaining quality of life, and maintaining sagittal alignment of the spine.

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INTRODUCTION:
It has been reported that maintenance of the three sagittal modifiers of the SRS-Schwab ASD classification such as PI-LL (PI: Pelvic Incidence, LL: Lumbar Lordosis), PT (Pelvic Tilt) and SVA (Sagittal Vertical Axis) is useful in maintaining quality of life. However, there are limited longitudinal studies whether maintenance of back muscle strength and other limb and trunk muscles contributes to maintenance of these three sagittal modifiers, prevention of low back pain, and maintenance of quality of life. For this reason, this study was conducted.
METHODS:
A total 109 healthy female (mean age 65.2 years (56-80) at first examination) who participated in the community health checkup were evaluated. 85 were evaluated for 5 years and 24 for 10 years. RDQ (Roland Morris questionnaire: 0-24 pts.) and VAS (visual analog scale: 0-100mm) were measured as clinical items. LL, PI, PT, SS (sacral slope), and SVA were measured using standing whole spinal sagittal X-ray as radiographic items. Abdominal, back, quadriceps, and iliopsoas muscles were also measured by muscle dynamometer as muscle strength items. First, correlations coefficient among clinical items, radiographic items, and the number of Schwab sagittal modifiers (Schwab-SMs: 0-6 pts.) (SVA<40mm=0, 40-95mm=1, >95mm=2, PI-LL<10°=0, 10-20°=1, >20°=2, PT<20°=0, 20-30°=1, >30°=2) were evaluated using Spearman's rank correlation coefficient. We also examined what the differences of correlation trends existed among the three groups: under 65 years, 65-74 years, and 75 years and older, respectively. Next, in 5-year and 10-year longitudinal study, the correlation among the variation of the clinical items, the variation of the muscle strength and the variation of each of the sagittal modifier item were evaluated using Spearman's rank correlation coefficient. We also compared the groups in which SVA worsened by 40 mm or more, PI-LL worsened by 10° or more, and PT worsened by 10° or more during 5-year and 10-year period with those in which they were maintained, and evaluated whether there were differences in mean muscle strength change and mean clinical item change using the Mann-Whitney U test.
RESULTS:
The rank correlation coefficients r between Schwab-SMs and clinical or muscle strength items were age (r=0.405: p<0.001), RDQ (r=0.402: p<0.001), VAS (r=0.277: p<0.001) and back muscle (r=-.0320: p<0.001). Especially, only back muscle strength (r=-0.247: p=0.087) was correlated with Schwab-SMs in the age group of under 64 years and only age (r=0.379: p=0.032) was correlated in those over 75 years. However, many factors such as VAS (r=-0.274: p=0.009), RDQ (r=-0.535: p<0.001) and VAS (r=-0.523: p<0.001) were correlated with Schwab-SMs in the age group of 65~74 years. Next, in the longitudinal 5-year study, we found a negative correlation between back muscles and RDQ (r=-0.609; p=0.006) and a trend toward a negative correlation between back muscles and VAS (r=-0.020; p=0.066), but no other correlation among muscle strength and clinical items, or each item of the sagittal modifier. On the other hand, the 10-year longitudinal study found a negative correlation between back muscles and SVA (r=-0.42; p=0.04), back muscles and PT (r=-0.41; p=0.04). Finally, the group with PI-LL>10 in the 5-year longitudinal study tended to have decreased quadriceps (worsening group: 6.50N decrease, maintenance group: 1.25N decrease; p=0.029). In a 10-year longitudinal study, the group with SVA>40 showed a significant difference in dorsal muscle weakness (worsening group: 34.0N decrease, maintenance group: 40.4N increase; p=0.04). The group with PI-LL>10 showed a trend toward back muscle weakness (worsening group: 27.5N decrease, maintenance group: 40.5N increase; p=0.10).
DISCUSSION AND CONCLUSION:
Hira et al. reported that worsening SVA correlates with back pain and ODI and leads to worsening activities of daily living-related activities in a general adult study. In our current longitudinal study, limb and trunk muscle strength, especially back muscles, correlated with the Schwab sagittal modifiers and RDQ and VAS. Therefore, it was suggested that maintenance of back muscle strength might contribute to the maintenance of sagittal alignment of the spine, quality of life, and prevention of back pain exacerbation. In addition, the correlation between back muscles and clinical parameters and sagittal modifiers was relatively strong in the 65-74 age group. So maintenance and improvement of limb and trunk muscle strength through exercise therapy in this age group might be more useful in maintaining quality of life and preventing back pain in old generations. （Ref.1 Hira et al. Sci Rep 2021）