

# The Correlation between Thyroid Hormone Levels with Functional Mobility Performance among the Geriatric Patients in Dr. Sardjito General Hospital

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## Abstract

**Background.** Alteration of the endocrine system in the elderly people may be caused by changes in secreted hormone levels or decreased sensitivity of target organs. These changes also apply to thyroid function, which can cause disability, cognitive impairment, cardiovascular risk, and decreased muscle mass and strength in the elderly. Physiologically, there are several changes in the concentration of thyroid hormone Concentrations due to aging process, such as reduced TSH (Thyroid Stimulating Hormone), total T<sub>3</sub> (Triiodothyronine) and free T<sub>3</sub> levels, and increased rT<sub>3</sub> (Reverse triiodothyronine), which is an inactive T<sub>4</sub> (Thyroxine) metabolite in the serum. Even so, the free T<sub>4</sub> and the total T<sub>4</sub> remain unchanged, except for the sick. As a result, proper diagnosis and management are expected to minimize the deprivation experienced by the subjects due to a decrease in functional mobility.

**Aims.** The aim of the study was to assess the correlation between the levels of thyroid hormones and functional mobility among the elderly at Dr. Sardjito General Hospital, Yogyakarta.

**Method.** Observational descriptive and analytical study with cross-section design was performed. Subjects were recruited used a consecutive sampling method for subjects who met the inclusion and exclusion criteria. The statistical analysis used to find a correlation between the levels of the thyroid hormone and the performance of the functional mobility by Pearson Correlation test. Here the study used Spearman Correlation test if the conditions were not met the criteria. Significance limit with  $p < 0.05$ .

**Results.** A total of 36 research subjects who met the inclusion and exclusion criteria. The mean age was  $69.67 \pm 6.164$  years. Consisted of 16 (44.4%) male and 20 (55.6%) were female. The median of TSH (Thyroid Stimulating Hormone) was 1.170 (0.19-3.64)  $\mu\text{IU/mL}$  and the median free T<sub>4</sub> was 1.280 (0.80-2.34)  $\text{ng/dL}$ . TSH level in male was more than female with same time in gait speed. The male median TSH level was 1.370 (0.60-3.64)  $\mu\text{IU/mL}$  and women 0.980 (0.19-3.17)  $\mu\text{IU/mL}$ . Slow gait speed more than thirty second (high risk of falling), the TSH mean in mas was 2.690  $\mu\text{IU/mL}$  and women 1.150  $\mu\text{IU/mL}$ . The test results indicate thyroid hormone level has no significant effect on functional mobility performance (timed up and go test score) in the elderly subjects ( $p \text{ value}=0.531$ ) and with level Free T<sub>4</sub> ( $p \text{ value}=0.721$ ).

**Conclusion:** In this study population, thyroid hormones did not have a statistically significant correlation with functional mobility in the elderly. Males with higher serum levels and females with lower serum TSH (Thyroid Stimulating Hormone) were at increased risk of frailty.

**Keywords:** *Thyroid hormone levels, functional mobility, timed up and go test scores*

## Abstrak

**Latar Belakang:** Berubahnya sistem endokrin pada lansia bisa disebabkan perubahan jumlah hormon yang dikeluarkan atau gangguan sensitivitas pada target organ. Perubahan ini juga berlaku pada fungsi tiroid, sehingga dapat menyebabkan disabilitas, gangguan kognitif, risiko kardiovaskular, dan penurunan massa serta kekuatan otot pada lansia. Secara fisiologis beberapa perubahan terjadi pada konsentrasi hormon tiroid seiring proses penuaan. Yaitu penurunan kadar TSH (Thyroid Stimulating Hormone), berkurangnya kadar  $T_3$  total dan  $T_3$  bebas, serta terjadi peningkatan  $rT_3$  yang merupakan metabolit inaktif dari  $T_4$  di dalam serum.

**Tujuan:** Menganalisis hubungan antara kadar hormon tiroid dengan kemampuan mobilitas fungsional pada lanjut usia di RSUP Dr. Sardjito Yogyakarta.

**Metode:** Penelitian ini merupakan penelitian observasional deskriptif dan analitik dengan disain cross sectional. Pemilihan subjek penelitian menggunakan metode consecutive sampling pada subjek yang memenuhi kriteria inklusi dan eksklusi.

**Analisa statistik:** untuk mencari korelasi kadar hormon tiroid dengan kemampuan mobilitas fungsional dinilai dengan uji korelasi pearson atau uji korelasi Sperman, apabila syarat uji korelasi pearson tidak terpenuhi. Batas kemaknaan yang diterima bila  $p < 0,05$ .

**Hasil penelitian :** Dari 36 subyek penelitian yang memenuhi kriteria inklusi dan eksklusi didapatkan rerata usia  $69,67 \pm 6,164$  tahun, subyek laki-laki 16 (44,4%) orang dan perempuan 20 (55,6%) orang. Median kadar TSH 1,170 (0,19-3,64)  $\mu IU/mL$ , median  $T_4$  bebas 1,280 (0,80-2,34)  $ng/dL$ , rerata kadar TSH laki-laki lebih tinggi dari perempuan dengan kecepatan berjalan yang sama nilai median laki-laki 1,370 (0,60-3,64)  $\mu IU/mL$  dan perempuan 0,980 (0,19-3,17)  $\mu IU/mL$ . Pada kecepatan berjalan lebih dari 30 detik (memiliki gangguan keseimbangan dan beresiko tinggi jatuh), Subyek laki-laki rerata TSH 2,690  $\mu IU/mL$  dan perempuan 1,150  $\mu IU/mL$ . Hasil uji menunjukkan kadar TSH tidak memiliki pengaruh yang signifikan terhadap kemampuan mobilitas fungsional (TUGt) pada lanjut usia ( $p$  value=0,531) dan kadar  $T_4$  bebas ( $p$  value=0,721).

**Kesimpulan:** Pada populasi penelitian ini didapatkan bahwa secara statistik kadar TSH dan  $T_4$  bebas tidak memiliki hubungan yang signifikan dengan kemampuan mobilitas fungsional pada lanjut usia. Laki-laki dengan kadar serum TSH meningkat dan perempuan dengan kadar serum TSH menurun sama-sama memiliki risiko meningkatnya kelemahan otot.

**Kata Kunci:** kadar Thyroid Stimulating Hormon (TSH), kadar  $T_4$  bebas (Thyroxine), Kemampuan mobilitas fungsional, Skor timed up and go test (TUGt), Lanjut Usia

## Introduction

Alteration of the endocrine system in the elderly may be changed the levels of the secreted hormones or a decrease in the sensitivity of the target organs. These changes also apply to thyroid function, which can cause disability, cognitive impairment, cardiovascular risk, and decreased muscle mass and strength in the elderly.<sup>1</sup> Physiologically, there are several changes in the concentration of thyroid hormones due to the aging process, such as reduced TSH (Thyroid Stimulating Hormone), total  $T_3$  and free  $T_3$  levels, and increased  $rT_3$ ,

which is an inactive  $T_4$  metabolite in the serum. Even so, the free  $T_4$  and the total  $T_4$  remain unchanged, except for sick individuals.<sup>2</sup>

Gait problems and falls among the elderly are one of the most important subjects in the field of medical gerontology and are among the geriatric giants. The problems of gait and falls are two interrelated subjects. Falls can simply be interpreted as an event that causes someone to suddenly be in a lower position than the previous position, with or without loss of consciousness or injury and unintentionally. Gait disorders are reduced walking speed or reduced smoothness, symmetry, and sequence of body movements.<sup>3</sup>

Consequently, proper diagnosis and management are expected to minimize the deprivation experienced by the sufferers due to a decrease in functional mobility.

The purpose of this study was to assess the correlation between the levels of thyroid hormone and functional mobility (Timed up and go test score) among elderly patients, so the results of this study may be used as additional information for the community, medical society or for further studies.

## Methods

This research was a cross-sectional observational, descriptive, and analytical study. Subjects were recruited used a consecutive sampling method among subjects who met the inclusion and exclusion criteria. The study was performed in April to December 2018 at the Geriatric outpatient clinic of Dr. Sardjito General hospital, Yogyakarta.

Subjects were elderly patients ( $\geq 60$  years) who visited Geriatric outpatient clinic of Dr. Sardjito General hospital, Yogyakarta. The inclusion criteria were elderly patients ( $\geq 60$  years) and gave their consent to be included in the study. Exclusion criteria were injuries or defects of the lower extremities, which may cause movement disorders, chronic

heart failure, under treatment with drugs that decreased muscle strength.

Subjects were asked to fill out an informed consent form, followed by interviews (identity, disease history, history of treatment and history of falls) either through auto anamnesis or alloanamnesis, physical examinations (to identify any wound or limb defects), anthropometric measurements (weight and height), Blood pressure test and at the end of the “Timed Up and Go” test (TUG test) where subjects were asked to sit in a chair, then get up from the chair followed by 3 m of walking, turn around and return to the chair and sat back as the original position, then the examiner calculates the time needed to complete the “Timed Up and Go” test.<sup>4,5,6.</sup>

Blood samples were retrieved for thyroid hormone levels (*Thyroid Stimulating Hormones* and *Thyroxine*). The data obtained in this study were the primary data from the results of an interview, physical examination, “Timed Up and Go” test, thyroid hormone levels and strength of the correlation were tested by Pearson correlation test if the data had normal distribution and Spearman’s rho test if the data were skewed.

Wall JC. The Timed Get-up and Go Test Revisited: Measurement of the component Task. Journal of rehabilitation Research & Development 2000; 37: 109-114<sup>7</sup>

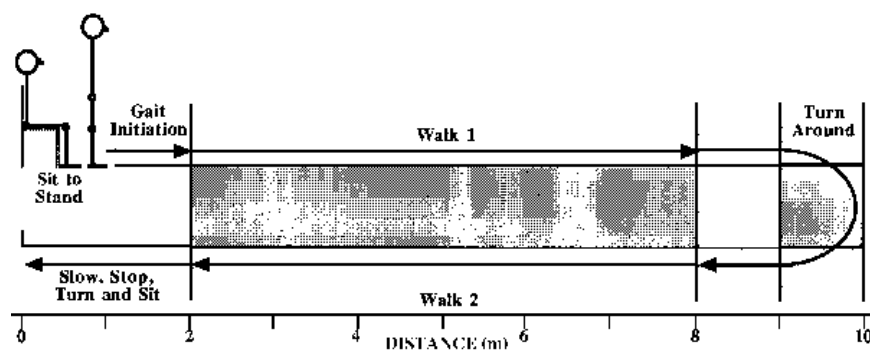


Figure 1. Timed up and go basic scheme

**Table 1.** Subjects characteristics

Variables	n (%)	Mean ± SD	Median (Min-Max)
<b>Age (years)</b>		69.67 ± 6.164	68.00 (61 - 82)
<b>Gender</b>			
Male	16 (44.4%)		
Female	20 (55.6%)		
<b>Thyroid hormone levels</b>			
TSH		1.364 ± 0.810	1.170 (0.19 - 3,64)
Free T4		1.284 ± 0.258	1.280 (0.80 – 2.34)
<b>Timed Up and Go Test scores</b>		20.987 ± 7.196	18.110 (9.10 – 44.0)
<10 seconds	1 (2.8%)		
10-19 seconds	18 (50.0%)		
20-29 seconds	13 (36.1%)		
> 30 seconds	4 (11.1%)		
<b>Weight (kg)</b>		56.53 ± 9.95	56.50 (31 - 74)
<b>Height (cm)</b>		157.33 ± 6.423	157.50 (145–169)
<b>Nutritional status</b>		22.88 ± 4.183	22.92 (13.78–30.22)
Underweight	4 (11.1%)		
Normal	19 (52.8%)		
Overweight	7 (19.4)		
Obesity	6 (16.7%)		

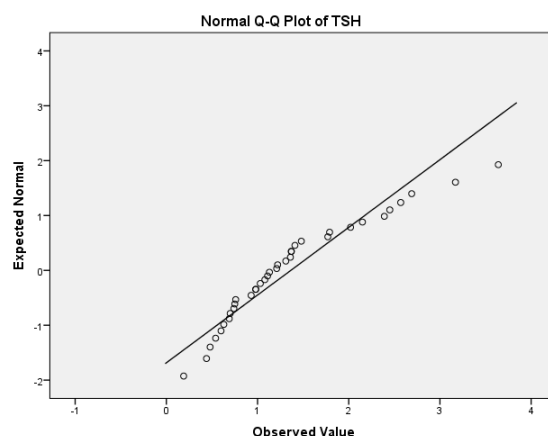
**Results**

Normality test results found that all variables did not have a normal distribution with (a) Thyroid Stimulating Hormone had  $p < 0.05$  ( $p = 0.007$ ), (b) Free T4 had  $p < 0.05$  ( $p = 0.000$ ), and (c) Timed Up and Go had  $p < 0.05$  ( $p = 0.000$ ). Data transformation has been performed to normalize the data. Free T4 and Timed Up and Go tests were still abnormally distributed with  $p = 0.011$  and  $p = 0.009$  ( $p < 0.05$ ). Since the data distributions were not normal, a non-parametric test with Spearman’s rho test was selected. From 36 patients who agreed to be recruited as subjects, data were described in Table 1.

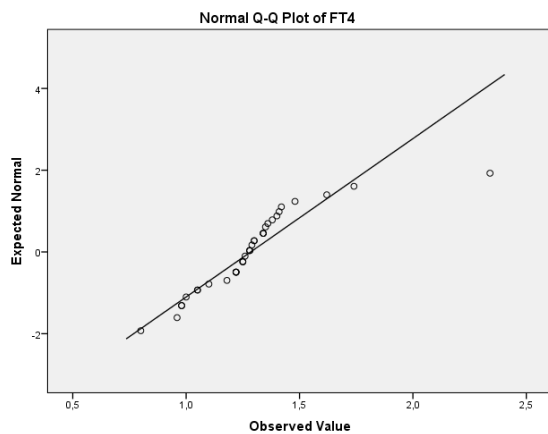
Alteration of the endocrine system in the elderly caused by changes in the levels of the secreted hormones and a decrease in the sensitivity of the target organs. These changes also apply to thyroid function, which caused disability, cognitive impairment, cardiovascular risk, and decreased muscle mass and strength in the elderly.<sup>1</sup>

**Table 2.** Characteristics of subjects based on age

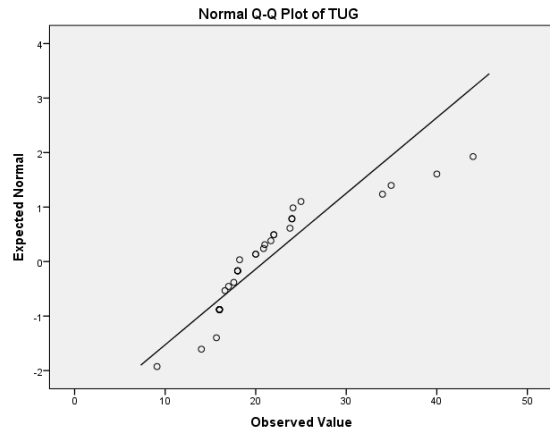
Age	Frequency	%
60 - 74 years old (elderly)	27	75.0%
Male	10	62.5%
Female	17	85.0%
75 - 90 years old (old)	9	25.0%
Male	6	37.5%
Female	3	15.0%



**Figure 2.** Scatter plot graph of Thyroid Stimulating Hormone (TSH) levels



**Figure 3.** Scatter plot graph of Thyroxine (Free T4)



**Figure 4.** Scatter plot graph of Timed Up and Go test (TUG)

**Table 3.** Characteristics of thyroid hormone levels based on age

Characteristics	n (%)	Age			
		60 - 74 years		75 - 90 years	
		Mean ± SD	Median (Min-Max)	Mean ± SD	Median (Min-Max)
TSH	36	1.395 ± 0.823	1.210 (0.19–0.64)	1.273 ± 0.809	0.980 (0.60– 2.69)
Free T4	36	1.256 ± 0.272	1.260 (0.80-2.34)	1.367 ± 0.198	1.340 (1.10-1.74)

Notes: TSH = *Thyroid Stimulating Hormone*, free T4= *Thyroxine*

**Table 4.** Characteristics of thyroid hormone levels based on gender

Characteristics	Gender					
	Male			Female		
	n	Mean ± SD	Median (Min-Max)	n	Mean ± SD	Median (Min-Max)
<b>TSH</b>	16	1.665 ± 0.846	1.370 (0.60–3.64)	20	1.124 ± 0.711	0.980 (0.19–3.17)
60-74 years	10	1.809 ± 0.783	1.390 (1.11-3.64)	17	1.151 ± 0.766	0.980 (0.19-3.17)
75-90 years	6	1.426 ± 0.967	1.035 (0.60-2.69)	3	0.966 ± 0.260	0.980 (0.70-1.22)
<b>Free T4</b>	16	1.368 ± 0.326	1.290 (0.98–2.34)	20	1.217 ± 0.167	1.250 (0.80-1.42)
60-74 years	10	1.358 ± 0.379	1.280 (0.98-2.34)	17	1.197 ± 0.172	1.250 (0.80-1.42)
75-90 years	6	1.386 ± 0.244	1.320 (1.10-1,74)	3	1.330 ± 0.070	1.360 (1.25-1.38)

Notes: TSH = *Thyroid Stimulating Hormone*, free T4 = *Thyroxine*

**Table 5.** Characteristics of *Timed Up and Go test* scores based on age and gender

Characteristics	<i>Timed up and go test</i>			
	<10 seconds	10-19 seconds	20-30 seconds	> 30 seconds
<b>60 - 74 years</b>	1 (3.7%)	14 (51.9%)	9 (33.3%)	3 (11.1%)
Male	0 (0.0%)	6 (60.0%)	4 (40.0%)	0 (0.0%)
Female	1 (5.9%)	8 (47.1%)	5 (29.4%)	3 (17.6%)
<b>75 - 90 years</b>	0 (0.0%)	4 (44.4)	4 (44.4%)	1 (11.1)
Male	0 (0.0%)	1 (16.7%)	4 (66.7%)	1 (16.7%)
Female	0 (0.0%)	3 (100%)	0 (0.0%)	0 (0.0%)
<b>Total</b>	1 (2.8)	18 (50.0)	13 (36.1)	4 (11.1)

**Table 6.** Characteristics of mean thyroid hormone levels based on the *Timed up and go test* (TUG) scores

Characteristics	<i>Timed up and go test</i>				Total	
	<10 seconds	10-19 seconds	20-30 seconds	> 30 seconds	Median (min-max)	Mean $\pm$ SD
<b>TSH</b>	3.170	1.196	1.406	1.364	1.170 (0.19-3.64)	1.364 $\pm$ 0.810
Male	0.00	1.701	1.506	2.690	1.370 (0.60-3.64)	1.665 $\pm$ 0.846
Female	3.170	0.875	1.246	1.150	0.980 (0.19-3.17)	1.124 $\pm$ 0.711
<b>Free T4</b>	1.250	1.253	1.358	1.240	1.280 (0.80-2.34)	1.284 $\pm$ 0.258
Male	0.00	1.288	1.442	1.340	1.290 (0.98-2.34)	1.368 $\pm$ 0.326
Female	1.250	1.231	1.224	1.140	1.250 (0.80-1.42)	1.217 $\pm$ 0.167

**Table 7.** Correlation between thyroid hormone levels and functional mobility

Variables	Timed Up and Go Test	
	correlation coefficient (r)	p
TSH	0.108	0.531
Free T4	0.062	0.721
<b>Male</b>		
TSH	0.228	0.395
Free T4	0.016	0.952
<b>Female</b>		
TSH	0.031	0, 898
Free T4	0.087	0.715

Notes: Spearman's rho p <0.05 is significant, TSH = Thyroid stimulating hormone, Free T4 = Thyroxine

## Discussion

Several physiological changes occur in thyroid hormone concentrations along with the aging process: decreased TSH levels, total T<sub>3</sub> levels and free T<sub>3</sub> levels, and increased rT<sub>3</sub>, which is an inactive T<sub>4</sub> metabolite in the serum. However, the free and total T<sub>4</sub> levels were often unchanged, except for sick individuals. It was known that the thyroid hormone functions to regulate the body's thermostat by modified of the basal metabolic rate. If the concentration of thyroid hormone changed physiologically, the overall physical function of the elderly would also change (Van den Beld *et al.*, 2005).<sup>2</sup> Based on these data, in accordance with the

theory, we found that with an increase in age the levels of thyroid hormones decreased and the levels of thyroid hormones in the older age group were lower even though they were still within the normal range of values.

This study was a descriptive analytic study with cross sectional design. The target population and subjects in this study were elderly patients > 60 years who visited Dr. Sardjito's Geriatric Outpatient Clinic. A total of 36 subjects, 16 male (44.4%) and 20 females (55.6%) participated in the study. At the beginning of the study, initial interviews, physical examination, functional mobility test (Timed Up and go test) and laboratory tests were performed. There was a correlation between thyroid hormone levels (TSH and free T4) and functional mobility as hypothesis.

In this study, we found that among 36 elderly subjects with a mean age of 69.67 years. Thyroid hormone levels were still within normal limits, in accordance with the value in healthy adults. We divided the age category based on the WHO classification into the elderly (60-74 years of age) and the elderly (75-90 years of age). The elderly group consisted of 27 subjects (75.0 %) with a mean TSH level of 1.395  $\mu$ IU/mL with a median of 1.210  $\mu$ IU/mL, while the old group was 1.273  $\mu$ IU/mL with a median of 0.980  $\mu$ IU/mL. Thyroxine

levels at age 60-74 years was 1.256 ng / dL with a median of 1.260 ng/dL, while at age 75-90 years it was 1.367 ng/dL with a median of 1.367 ng/dL. The older age group had lower levels of Thyroid Stimulating Hormone.

Normally, in healthy elderly people, physiological changes in thyroid function were common. As they grew old, the concentration of TSH and T3 free will decrease. Nicola Veronese, 2016, conducted a study on serum TSH levels and weakness in the elderly. The cohort study was performed on a population-aged  $\geq 65$  years in Italy with analysis of *Progetto Veneto Anziani* (Pro.VA). The sample size was 3099 (1854 females and 1245 males). Subjects were followed for up to 4 years after baseline data. The rationale of this study was that high or low TSH level was associated with poor conditions in the elderly, but the literature regarding the association between TSH and muscle weakness in the elderly was still lacking. The study concluded that male with increased serum TSH level and female with decreased serum TSH level were equally at risk of increased muscle weakness.

These findings suggested gender differences as an important determinant in the association between thyroid function and muscle weakness in the elderly. The study suggested that the TSH level can be used to predict muscle weakness in the elderly.

A cross-sectional study (Wang GC, et al, 2010 and Yeap BB, et al, 2012) and one longitudinal study did not find any significant association between TSH levels and weakness in the elderly. There might be some explanation for this difference. First, the longitudinal study by Virgini et al. (2015) followed 22 subjects with subclinical hyperthyroidism and 85 subjects with subclinical hypothyroidism and thus clearly has not enough power. It also used

FT4 data and this may give a more complete assessment of thyroid function. Second, Virgini et al. (2015) only recruited male subjects.<sup>13</sup> These may cause difficulties in generalization of results, especially in female. Finally, the different definition of weakness may result in different interpretation of the results. Given the above, Nicola Veronese *et al.* in their study considered that cross-sectional study and representative cohorts were the strongest studies to investigate the association between TSH and weakness, compared to previous literature.

We studied the general population (male and female) in the hope of providing a more complete view of thyroid hormone function and functional mobility in elderly. Our study results were in accordance with the theory that age thyroid hormone levels decreased but were limited by the design since no follow-up were performed like the previous studies.

There were 36 subjects who met the inclusion and exclusion criteria. The mean age was  $69.67 \pm 6.164$  years, 16 subjects were men (44.4%) and 20 were women (55.6%). The median TSH level was 1.170 (0.19-3.64)  $\mu$ IU/mL, median free T4 (Thyroxine) was 1.280 (0.80 - 2.34) ng/dL. The results suggested that thyroid hormone levels did not have a statistically significant correlation with functional mobility ability (timed up and go test score) in the elderly. Here, either between TSH level and functional mobility ( $r = -0.108$ ;  $p$  value = 0.531) or between Thyroxine (free T4) and functional mobility ( $r = 0.062$ ;  $p$  value = 0.721). Our conclusion was that thyroid hormones did not have statistically significant correlations with functional mobility in the elderly.

The limitation of this study was the study design we used. The design of this study was *cross-sectional*, did not use a more stringent

design that could reveal a relationship between the two variables or a cohort design that could assess the influence of thyroid hormone levels on functional mobility. Other limitations were the small sample size that may result in weak correlation; also, sample was taken only from the subjects visit to the health center and may not represent the general population. Follow up was not performed to investigate the changed in TSH and free T<sub>4</sub> (*Thyroxine*) levels, thus we cannot ascertain whether these changed were only temporary or permanent. Some characteristics that may affect thyroid hormone levels or muscle strength were comorbid disease, joint and connective tissue disease, thyroid drugs, thyroid gland surgery, radiation of the thyroid gland and surrounding area, Body Mass Index (BMI), Basal Metabolic Rate (BMR) were not analyzed that may also affected the study results.

## Conclusion

This study found the thyroid hormones did not have a statistically significant correlation with functional mobility in elderly. Here as result, the male population have the higher serum than in female of TSH levels which increased the risk of frailty. Future studies should be performed with cohort design, assess the association of thyroid hormone levels and functional mobility. More homogeneous sample in gender and age, to minimize the confounding factors.

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