



# Comparing Cardiac autonomic function between shift and non-shift firefighters in Taichung, Taiwan



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## Background

Most Taiwanese firefighters are 48on/24off shift work, longer than other countries in the world. We aimed to compare the heart rate variability among shift and non-shift firefighters working in Taichung, Taiwan. Due to the different types of cases in different areas, we divided the shift firefighters in countryside area and urban area.

## Methods

Cluster-sampling was used to recruit 90 firefighters from Fire Departments in Taichung, Taiwan. Group A (n=30), Group B (n=30), Group C (n=30) were non-shift work, shift work in countryside area, and shift work in urban area, respectively. Heart rate variability was used to examine the cardiac autonomic function at 4 phases, including 3 mins resting, 1 min deep breathing, 1 min Valsalva maneuver and 2 mins standing. These four conditions simulate physical stimulation to cardiac autonomic system in our everyday activities.

Data were expressed as mean  $\pm$  standard deviation. One way ANOVA with Bonferroni's post hoc test to compare the variables of cardiac autonomic nervous activity. The differences were considered significant at  $p<0.05$ .

## Conclusion

Non-shift group had poorer cardiac autonomic function, and there were no significant difference between shift groups in the countryside area and urban area.

In deep breathing phase, the current results showed that the non-shift group is associated with a blunted response of cardiac sympathetic activation (nLF).

The age and year of services of the non-shift group was greater than both shift groups, it may result in a poor cardiac autonomic function in non-shift group.

Non-shift firefighters used to work in shifts. This study did not analyze the duration of non-shift firefighters in non-shift group, which may affect the impact of shifts on the cardiac autonomic function of firefighters.

The results of this study showed that shifts have little effect on the cardiac autonomic function of firefighters. However, firefighters with long year of services may have poorer cardiac autonomic function and increase the risk of cardiovascular disease.

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## Results

Table 1. Characteristics of participants

	Group A N=30 (4)	Group B N=30 (3)	Group C N=30 (12)*
Age	33.07 $\pm$ 6.8	34.73 $\pm$ 6.4	42.67 $\pm$ 8.1*
Height (cm)	172.83 $\pm$ 6.0	171.67 $\pm$ 4.8	169.2 $\pm$ 6.1
Weight (kg)	73.8 $\pm$ 10.9	74.85 $\pm$ 15.0	69.8 $\pm$ 12.0
BMI (kg/m <sup>2</sup> )	24.63 $\pm$ 2.8	25.31 $\pm$ 4.5	24.24 $\pm$ 2.8
Year of services	7.87 $\pm$ 7.6	10.77 $\pm$ 6.0	16.47 $\pm$ 7.1*

Note : Mean  $\pm$  SD, N=total N (female)

\*P<0.05, A vs B vs C

In the descriptive analysis, there are significant differences in gender, age, and year of services between group C and groups A and B.

Table 2. cardiac autonomic activity in A, B, and C group

	Group A	Group B	Group C
<b>Resting</b>			
Heart rate (bpm)	71.87 $\pm$ 12.31	73.24 $\pm$ 9.07	76.71 $\pm$ 13.11
Heart rate variability			
SDNN	49.37 $\pm$ 18.99	54.16 $\pm$ 17.76*	41.26 $\pm$ 14.97*
RMSSD	39.44 $\pm$ 19.62	47.60 $\pm$ 21.47*	34.94 $\pm$ 19.1*
nLF	48.73 $\pm$ 16.23	57.52 $\pm$ 19.81	46.14 $\pm$ 23.65
nHF	21.65 $\pm$ 12.99	16.95 $\pm$ 13.19	21.01 $\pm$ 15.87
LF/HF	0.89 $\pm$ 0.50	1.04 $\pm$ 0.69	0.9 $\pm$ 0.4
<b>Deep breathing</b>			
Heart rate (bpm)	74.46 $\pm$ 10.69	74.13 $\pm$ 7.46	77.35 $\pm$ 11.39
Heart rate variability			
SDNN	91.07 $\pm$ 31.96+	84.68 $\pm$ 21.75	74.73 $\pm$ 21.47+
RMSSD	112.83 $\pm$ 42.64+	106.37 $\pm$ 29.93	84.85 $\pm$ 29.96+
nLF	87.93 $\pm$ 5.96+	88.24 $\pm$ 4.53*	81.55 $\pm$ 15.8*+
nHF	5.79 $\pm$ 2.99	6.26 $\pm$ 3.70	7.72 $\pm$ 6.22
LF/HF	0.53 $\pm$ 0.38	0.43 $\pm$ 0.26	0.51 $\pm$ 0.3
<b>Valsalva maneuver</b>			
Heart rate (bpm)	75.57 $\pm$ 10.04	75.80 $\pm$ 7.64	78.17 $\pm$ 12.93
Heart rate variability			
SDNN	101.40 $\pm$ 37.39	102.32 $\pm$ 27.21*	80.29 $\pm$ 37.59*
RMSSD	101.74 $\pm$ 35.42	108.63 $\pm$ 32.73*	78.96 $\pm$ 41.13*
nLF	83.25 $\pm$ 9.91	84.91 $\pm$ 8.75	80.01 $\pm$ 14.88
nHF	6.53 $\pm$ 3.96	5.97 $\pm$ 3.98	8.08 $\pm$ 5.74
LF/HF	1.8 $\pm$ 0.8	1.89 $\pm$ 0.71	1.69 $\pm$ 0.78
<b>Standing</b>			
Heart rate (bpm)	79.05 $\pm$ 12.58	81.76 $\pm$ 10.48	86.03 $\pm$ 13.87
Heart rate variability			
SDNN	52.58 $\pm$ 23.77	51.21 $\pm$ 17.36	41.92 $\pm$ 19.04
RMSSD	37.88 $\pm$ 17.10	38.98 $\pm$ 12.84	32.01 $\pm$ 16.11
nLF	61.70 $\pm$ 15.08	66.16 $\pm$ 21.0	61.38 $\pm$ 17.07
nHF	12.61 $\pm$ 8.37	10.58 $\pm$ 8.14	11.17 $\pm$ 6.93
LF/HF	1.61 $\pm$ 0.91	1.31 $\pm$ 0.45	1.25 $\pm$ 0.47

\*P<0.05, B vs C; +P<0.05, A vs C

SDNN, Standard Deviation of Normal-to-Normal R Wave; RMSSD, square root of mean sum of squares of successive interbeat differences; nHF, normalized high frequency power; nLF, normalized low frequency power; LF/HF, the ratio of low frequency power to high frequency power.

There were significant between-group difference in the SDNN, RMSSD at rest and in Valsalva maneuver, Group C had a significantly lower SDNN and RMSSD than Group B indicating a poorer heart rate variability.

There were significant between-group difference in SDNN, RMSSD and nLF in deep breathing phase. SDNN, RMSSD and nLF in Group C were lower than Group A and nLF in Group C was lower than Group B.

No significant difference was found among the three groups in standing phase.