The Autonomic Nervous System and Big Five Personality

Yanti Ivana Suryanto[1*]*, Esdras* Ardi Pramudita[1], and *Lucas* Nando Nugraha[1]

[1]Fakultas Kedokteran Universitas Kristen Duta Wacana, Yogyakarta, Indonesia

Abstract. Background: Covid-19 brings change to human life. Human should adapt with this condition. People with certain personality trait may respond differently to the same situation. The autonomic nervous system (ANS) is important for regulation of human body function. It plays an important role in the physiological responses that arise in response to events around humans. Objective: to identify relationship between ANS function and personality. Methodology: We studied autonomic nervous system function and personality of 64 subjects older than 18 years old. Subjects with ANS dysregulation that had been diagnosed by physician were excluded. The Schellong test and The Big Five Personality questionnaire were used to identify ANS function and personality respectively. Relationship between variables was identified using Spearman test. Results: Autonomic nervous system function of the subject were normal (79.7%), type-1 (14.1%), type-2a (3.1%) and type-3 (3.1%). Subjects which have high openness personality were 36%, high conscientiousness were 70%, high extraversion personality were 50%, high agreeableness personality were 91%, and low neuroticism were 92%. There was no relationship between ANS function and openness (p=0.49), extraversion (p=0.34), agreeableness (p=0.77), and neuroticism (p=0.90). There was a relationship between ANS function and conscientiousness (p=0.049). Conclusion: There was a relationship between ANS function and conscientiousness but not with other types of OCEAN personality. Keywords: autonomic nervous system function, Schellong test, big five personality, OCEAN.

1 Introduction

Covid-19 bring a lot of impacts on human wellbeing, including mental health [1], [2]. Many things could become stressor for people, such as workload, feeling afraid of getting infected, negative stigma as a carrier, food limitation, jobless [3], learning from home [4], physical distancing [5], etc. Limitation to gather or meet others made people uncomfortable. Some mental health problems occur such as lack of confidence, sleeping disturbance, energy lacking, anxiety, depression, trauma [5], [6].

Stressor would physiologically encourage the body to seek adaptation through allostasis, so that stability/adaptation is achieved through the activation of various body systems. The body systems involved include the hypothalamic-pituitary-adrenal (HPA) axis, the autonomic nervous system (sympathetic and parasympathetic), the immune system and some metabolic hormones. Sympathetic nervous system activation is the first and fastest response [7], [8]. The autonomic nervous system regulates various systems in human body. Dysautonomia is associated with several clinical manifestation, some are debilitating and could increase mortality [9].

The way to cope with stressor is different for each person depending on his/her resource [10]. Stress could be good stress, tolerable stress, and toxic stress [7]. Big five personality traits influences someone's perception on stressors [11], [12]. In big five personality there are five factors which are openness, conscientiousness, extraversion, agreeableness, and neuroticism (OCEAN personalities). People with openness personality has independent mind, more intellect, and imaginative. Good responsibility and orderly manner have been shown by people with high conscientiousness personality. People with extraversion dominance show full of energetic appearance, assertive, and talkative. People with high score of agreeableness usually show cooperation and good nature when interact with others. They are also trustful. People with neuroticism personality show easily agitated behaviour. They get upset easily [13]. Personalities that have been associated with health promoting behaviours are conscientiousness, agreeableness, and emotional stability (low neuroticism) [14]. People with low conscientiousness may have increased mental ill-health [15].

Person with certain personality trait showed different reaction to same stressor. The body reaction is regulated by ANS. This study was held to identify the relationship between autonomic nervous system function and personality.

2 Materials and methods

This study was a cross sectional study. This study was approved by Ethical Committee of Medical Faculty Duta Wacana Christian University with number 1189/C.16/FK/2020.

* Corresponding author: yanti_iv@staff.ukdw.ac.id

2.1 Subjects

This study focused on adulthood which has more mature neurocircuitry and neurologic function than children or adolescent [16]. Simple random sampling was used to recruit sample from university member of a private university. Participants were recruited with inclusion criteria as follow: age more than 18 years old and agreed to participate. To ensure participants willingness to participate, written informed consent was given. Participants with autonomic nervous system dysregulation which had been diagnosed by physician and incomplete data were excluded.

2.2 Methods

Age and gender were identified using questionnaire. Personality was identified using Big Five Personality questionnaire (adapted from John & Srivastava [13]). The test consists of forty-four items that must be rated on how true each item described about participants. There are five points scale which were 1-Strongly disagree, 2-Disagree, 3-Neutral, 4-Agree, and 5-Strongly Agree. Ten questions refer to openness, 9 questions refer to conscientiousness, 7 questions refer to extraversion, 9 questions refer to agreeableness, and 8 questions refer to neuroticism.
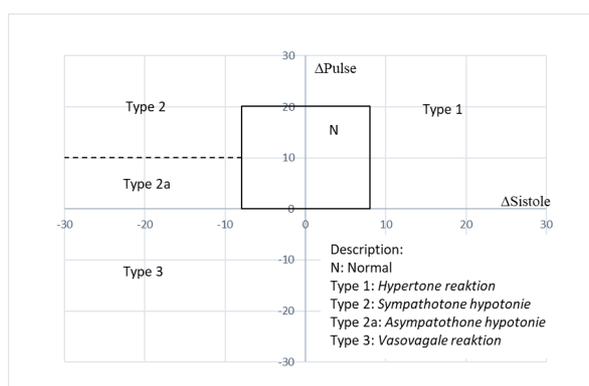

Figure 1. The Schellong test diagram [17]

Autonomic nervous function was identified using the Schellong test. Subject's blood pressure and heart rate were measured in five minutes (in a supine position) at 1-min intervals. Then subjects were asked to stand up until 7 minutes, blood pressure and heart rate were measured at 1-min intervals. The result in first five minute were averaged as baseline data. The changes of systolic blood pressure and heart rate from baseline were input to diagram in Figure 1. It was categorized as normal, type-1 (*hypertone reaktion*), type-2 (*sympathotone hypotonie*), type-2a (*asympathotone hypotonie*), and type-3 (*vasovagale reaktion*) [17].

2.3 Statistical Analysis

Correlation between autonomic nervous function and personality was identified using Spearman test with significance level of $p < 0,05$. Stata 15.1 was used for this purpose.

3 Result and discussion

3.1 Result

There were 66 subjects that agreed to participate, but only 64 subject which met the inclusion and exclusion criteria. There were 24 male and 40 females with age 37.05 ± 7.09 (mean $\pm$ SD) years old. The Schellong test result distribution of the participants was as follow: normal (51 [79.69%] participants), type 1 or *hypertone reaktion* (9 [14.06%] participants), type 2a or *asympathikotone reaktion* (2 [3.13%] participants), and type 3 or *vasovagale reaktion* (2 [3.13%] participants).

Table 1. Distribution of the OCEAN score.

Components	Amount	Percentage (%)
O Score average	41	62.12
O Score high	25	37.88
O Score low	0	0.00
C Score average	19	28.79
C Score high	47	71.21
C Score low	0	0.00
E Score average	33	50.00
E Score high	33	50.00
E Score low	0	0.00
A Score average	6	9.09
A Score high	60	90.91
A Score low	0	0.00
N Score average	60	90.91
N Score high	5	7.58
N Score low	1	1.52

The OCEAN personality consists of 5 components, namely openness, conscientiousness, extraversion, agreeableness, and neuroticism. Participants with score less than 30% were categorized as low, from 30 – 70% were categorized as normal, and more than 70% were categorized high for each component. Distribution of OCEAN score was described in Table 1. More participants had normal score of openness and neuroticism. More participants had high score of conscientiousness and agreeableness. There was equal percentage of participants with normal and high score of extraversion. Table 2 show distribution of personality type based on the results of the Schellong test.

Relationship of each component in personality and ANS function was identified using Spearman test. There was no relationship between ANS function and openness ($p=0.49$; $p>0.05$), extraversion ($p=0.34$; $p>0.05$), agreeableness ($p=0.77$; $p>0.05$), and neuroticism ($p=0.90$; $p>0.05$). There was a relationship between ANS function and conscientiousness ($p=0.049$; $p<0.05$).

3.2 Discussion

Stressful stimuli would trigger complex mechanisms in the body to overcome it. Wide diversity brain structure involved in detection and interpretation events as real or potential threats. The Hypothalamus-Pituitary-Adrenal (HPA) axis and the Sympathetic-Adreno-Medullar (SAM) axis are two major components in stress responses of the body. Substances such as cortisol and epinephrine or nor-epinephrine would be produced [18]. The body

Table 2. Percentage distribution of personality type based on the Schellong test

The Schellong Test Category			Nor-mal	1	2	2a	3	p
Personality	**O**	Low	0	0	0	0	0	0.49
		Average	53.13	7.81	0	0	3.13	
		High	26.56	6.25	0	3.13	0.00	
	C	Low	0	0	0	0	0	0.049
		Average	28.13	1.56	0	0	0	
		High	51.56	12.5	0	3.13	3.13	
	E	Low	0	0	0	0	0	0.34
		Average	42.19	6.25	0	0	1.56	
		High	37.50	7.81	0	3.13	1.56	
	A	Low	0	0	0	0	0	0.77
		Average	7.81	1.56	0	0	0	
		High	71.88	12.5	0	3.13	3.13	
	N	Low	1.56	0	0	0	0	0.9
		Average	71.88	12.5	0	3.13	3.13	
		High	6.25	1.56	0	0	0	

tend to activate the sympathetic nervous system and inhibit the parasympathetic nervous system as a general response to stressful condition. These conditions prepare the body to fight the stressor or flight from it [19]. Activation of SAM axis in response to a stressor happens before activation of HPA axis. The parasympathetic system facilitates the sympathetic response to stress by withdrawing its inhibitory effects [20].

Beside responding to stressful experience, autonomic nervous system should keep various vital organs functions such as cardiovascular, digestive, genito-urinary systems [19]. Dysautonomia is a term to describe clinical conditions that reveal autonomic nervous system failure. Dysautonomia are classified as postural orthostatic tachycardia syndrome (POTS), reflex (vasovagal) syndrome, neurogenic orthostatic hypotension (NOH), chronic fatigue syndrome, and carotid sinus hypersensitivity syndrome. Some test procedure could reveal autonomic nervous system functions such as the Schellong test, tilt-table test [21], and heart rate variability [22].

This study used the Schellong test to identify autonomic functions. More participants had normal ANS function than abnormal. In normal group, sympathetic and parasympathetic were balance. Participants in type 1 group had hyperactivity of sympathetic nervous system. High sympathetic nerve activity could result in the occurrence of various adverse conditions, in the present or in the future day. These conditions included cardiovascular system disorders (congestive heart failure, essential hypertension, carotid endarterectomy, myocardial infarction, hyper-dynamic circulation syndrome), balance disorder (baroreflex failure, postural tachycardia syndrome, brain and nerve disfunction (intracranial haemorrhage, autonomic epilepsy, Gullain-Barre syndrome), psychologic disorder (panic disorder, melancholic depression), norepinephrine transporter deficiency, hypothyroidism, and renovascular

hypertension [23]. Participants in type 2a group had *asympathikotone reaktion* or *asympathotone hypotonie*. In this group, sympathetic activity was drained so that parasympathetic tone is higher. This phenomenon fitted with the explanation of the polyvagal theory by Porges as follows. In fight or flight defence there is an increase in sympathetic activity. This situation promotes mobilisation strategies and inhibit digestion. When manifested as shutdown, sympathetic activation is depressed. Parasympathetic (dorsal vagal origin) domination would promote fainting, defecation, and inhibition of motor behaviour [24].This *vasovagale reaction* is seen in type 3 group.

Many practices change in post-Covid-19 era which known as new norms. This changing potentially brings significant economic and social effect [25]. Person should adapt with this condition. Personality trait could impact the adaptation processes. The most potent noncognitive construct for occupational performance is conscientiousness. Person with conscientiousness personality has motivations for goal directed performance, commitment, proficient performance, and conventional goals. They also have good impulse control. These characters and abilities are good for occupational performance. They prefer a more predictable environment. This may made them get stress easily in unpredictable situation. Conscientiousness person also organized, disciplined, detail-oriented, thoughtful, and careful. They have persistence and interpersonal responsibility for shared goals. They tend to have self-regulatory restraint and perseverance to avoid counter productivity [26], [27]. With those characters, persons with conscientiousness dominancy could be too hard on themselves. If this happens for a long period of time, it can have a bad impact on their wellness.

Relationship between personality and biological responses to emotion was described by Brumbaugh. Women with conscientiousness trait was associated with

increase of heart rate with gun scene [28]. Blahunkova revealed the significant correlations between conscientiousness and heart rate variability. The relationship indicated increased parasympathetic activity and higher heart rate variability [29]. From this study, conscientiousness score had relationship with autonomic nervous function, which mean that the higher the score, the higher the type. Person with high conscientiousness had higher potential to be in type-3 or having *vasovagale reaktion*. In type-3, parasympathetic nervous system is dominant. This condition could harm the body if the sympathetic function has been drained so that parasympathetic dominates the body functions. This result still needs to be confirmed with research which could identify sympathetic and parasympathetic balance objectively.

4 Conclusion

There was a relationship between ANS function and conscientiousness personality but not with another personality in OCEAN personality. From this study a person with high conscientiousness personality should aware and prepare themselves for keeping their healthiness in post-Covid-19 pandemic era.

References

1. A. S. Al Dhaheri *et al.*, *Impact of COVID-19 on mental health and quality of life: Is there any effect? A crosssectional study of the MENA region*, PLoS One, vol. **16**, no. 3 March, pp. 1–17, (2021), doi: 10.1371/journal.pone.0249107.

2. M. Izzatika, R. A. Syakurah, and I. Bonita, *Indonesia ' s Mental Health Status during the Covid-19 Pandemic,* Indigenous, vol. **6**, no. 2, pp. 78–92, (2021), doi: 10.23917/indigenous.v6i2.11945.

3. R. T. Handayani, S. Kuntari, A. T. Darmayanti, A. Widiyanto, and J. T. Atmojo, *Faktor Penyebab Stres Pada Tenaga Kesehatan Dan Masyarakat Saat Pandemi Covid-19*, J. Keperawatan Jiwa, vol. **8**, no. 3, pp. 353–360, (2020).

4. J. Riazul and S. Harri, *Tingkat Stres Mahasiswa Mengikuti Pembelajaran Daring pada Masa Pandemi Covid-19*, J. Ris. dan Pengabdi. Masy., vol. **1**, no. 1, pp. 130–146, (2021).

5. G. Anindyajati *et al.*, *Anxiety and Its Associated Factors During the Initial Phase of the COVID-19 Pandemic in Indonesia*, Front. Psychiatry, vol. **12**, no. March, pp. 1–10, 2021, doi: 10.3389/fpsyt.2021.634585.

6. M. Tampubolon, F. Silalahi, and R. Siagian, *COVID-19 and mental health policy in Indonesia*, ASEAN J. Psychiatry, vol. **22**, no. 1, pp. 1–12, (2021), [Online]. Available: https://www.aseanjournalofpsychiatry.org/articles/covid19-and-mental-health-policy-in-indonesia.pdf.

7. B. S. McEwen, *Neurobiological and Systemic Effects of Chronic Stress*, Chronic Stress, vol. **1**, (2017), doi: 10.1177/2470547017692328.

8. R. Murison, *The Neurobiology of Stress*. Elsevier Inc., (2016).

9. E. A. Rocha, N. Mehta, M. Z. P. Távora-Mehta, C. F. Roncari, A. A. de L. Cidrão, and J. E. Neto, *Dysautonomia: A forgotten condition — part 1*, Arq. Bras. Cardiol., vol. **116**, no. 4, pp. 814–835, (2021), doi: 10.36660/abc.20200420.

10. S. E. Taylor, *Health psychology*, 10th ed. New York: Mc Graw Hill Education, (2018).

11. H. Zacher and C. W. Rudolph, *Big Five traits as predictors of perceived stressfulness of the COVID-19 pandemic*, Pers. Individ. Dif., vol. **175**, no. January, p. 110694, Jun. (2021), doi: 10.1016/j.paid.2021.110694.

12. A. Pollak, M. Dobrowolska, A. Timofiejczuk, and M. Paliga, *The effects of the big five personality traits on stress among robot programming students*, Sustain., vol. **12**, no. 12, pp. 1–10, (2020), doi: 10.3390/su12125196.

13. O. P. John and S. Srivastava, *The Big-Five trait taxonomy: History, measurement, and theoretical perspectives.*, in *Handbook of personality: Theory and Research,* vol. **2**, L. A. Pervin and O. P. John, Eds. New York: Guilford, pp. 102–138, (1999).

14. F. M. Sirois and J. K. Hirsch, *Big Five traits, affect balance and health behaviors: A self-regulation resource perspective*, Pers. Individ. Dif., vol. **87**, pp. 59–64, (2015), doi: 10.1016/j.paid.2015.07.031.

15. E. G. Lewis and J. M. Cardwell, *The big five personality traits, perfectionism and their association with mental health among UK students on professional degree programmes*, BMC Psychol., vol. **8**, no. 1, pp. 1–10, (2020), doi: 10.1186/s40359-020-00423-3.

16. M. Arain *et al.*, *Maturation of the adolescent brain*, Neuropsychiatr. Dis. Treat., vol. **9**, pp. 449–461, 2013, doi: 10.2147/NDT.S39776.

17. Z. M. Sofro, *Pengembangan penggunaan uji Schellong, pemetaan dan pengelolaan tonus simpatis*, Universitas Gadjah Mada, (2013).

18. L. D. Godoy, M. T. Rossignoli, P. Delfino-Pereira, N. Garcia-Cairasco, and E. H. de Lima Umeoka, *A Comprehensive Overview on Stress Neurobiology: Basic Concepts and Clinical Implications*, Front. Behav. Neurosci., vol. **12**, no. July, pp. 1–23, Jul. (2018), doi: 10.3389/fnbeh.2018.00127.

19. D. Robertson, I. Biaggioni, G. Burnstock, P. A. Low, and J. F. R. Paton, Eds., *Primer on the Autonomic Nervous System*, 3rd ed. San Diego, (2012).

20. S. W. Porges, *The polyvagal perspective*, Biol. Psychol., vol. **74**, no. 2, pp. 116–143, Feb. (2007), doi: 10.1016/j.biopsycho.2006.06.009.

21. E. Hlavacova, J. Chrenova, Z. Rausova, M. Vlcek, A. Penesova, and L. Dedik, *Identification of Regulatory Mechan anism of Orthostatic Response*,

Int. J. Biomed. Biol. Eng., vol. **7**, no. 5, pp. 209–214, (2013).

22. S. Laborde, E. Mosley, and J. F. Thayer, *Heart rate variability and cardiac vagal tone in psychophysiological research - Recommendations for experiment planning, data analysis, and data reporting*, Front. Psychol., vol. **8**, no. FEB, pp. 1–18, (2017), doi: 10.3389/fpsyg.2017.00213.

23. M. D. S. Goldstein, D. D. Robertson, M. Esler, and S. E. Straus, *NIH Conference Dysautonomias : Clinical Disorders of the Autonomic Nervous System*, no. May 2000, pp. 753–764, (2002).

24. S. W. Porges and D. Dana, Eds., *Clinical Application of The Polyvagal Theory: The Emergence of Polyvagal-Informed Therapies*. New York: WW Norton, (2018).

25. X. Lin, Y. Lin, Z. Hu, H. Alias, and L. P. Wong, *Practice of new normal lifestyles, economic and social disruption, and level of happiness among general public in China in the post-covid-19 era*, Risk Manag. Healthc. Policy, vol. **14**, pp. 3383–3393, 2021, doi: 10.2147/RMHP.S320448.

26. M. P. Wilmot and D. S. Ones, *A century of research on conscientiousness at work*, Proc. Natl. Acad. Sci. U. S. A., vol. **116**, no. 46, pp. 23004–23010, (2019), doi: 10.1073/pnas.1908430116.

27. A. G. Y. Lim, *The big five personality traits*, (2020), [Online]. Available: https://www.simplypsychology.org/big-five-personality.html.

28. C. C. Brumbaugh, R. Kothuri, C. Marci, C. Siefert, and D. D. Pfaff, *Physiological correlates of the big 5: Autonomic responses to video presentations*, Appl. Psychophysiol. Biofeedback, vol. **38**, no. 4, pp. 293–301, 2013, doi: 10.1007/s10484-013-9234-5.

29. S. Blahunkova, P. Solarikova, I. Brezina, D. Turonova, and J. Rajcani, *Autonomic Nervous System Activity in the Context of the ' Big Five ' Personality Model Aktivita autonómneho nervového systému v kontexte osobnostného modelu Big Five*, vol. **10**, no. 2, pp. 35–43, 2019, doi: 10.15452/PsyX.2019.10.0011.