

ORIGINAL ARTICLE

Effects of Tai Chi therapy on body mass index and physical index of intellectual disability

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Abstract

Aim: Continuous program development and application are necessary in order to manage the health and address the problems of secondary metabolic disorders for people with intellectual disabilities. This study examines the effects of Tai Chi therapy on body mass index (BMI) and physical index among people with intellectual disabilities.

Methods: A quasi-experimental study using a pretest-post-test control group, non-synchronized design was employed. Samples were in total 104 people with intellectual disabilities (experimental: $n = 67$, control: $n = 37$) in two facilities in South Korea. They were randomly allocated using a coin toss into the two groups. Tai Chi therapy as an experimental intervention was the Sun style Tai Chi exercise, which consists of the warm-up (5 min), main exercise (45 min), and finishing (meditation, 10 min). Tai Chi therapy was conducted twice a week for a total of 40 sessions for 5 months (1 hour each) by one professional instructor. Measures were general characteristics of study participants, BMI as degree of obesity, and physical index. Data were analyzed using the SPSS 21.0 program (descriptive statistics, χ^2 test, independent t test). A P value of less than .05 was considered statistically significant.

Results: There were statistically significant differences on fasting blood glucose ($t = 4.351$, $P < .001$) and high-density lipoprotein ($t = -2.052$, $P = .043$) in the physical index between the two groups.

Conclusions: Tai Chi therapy was an effective intervention for decreasing fasting blood glucose and for increasing high-density lipoprotein in those with intellectual disabilities. Tai Chi therapy can be implied as a nursing intervention for intellectual disabilities in nursing practice.

KEYWORDS

BMI, intellectual disability, physical index, Tai Chi therapy

1 | INTRODUCTION

As a result of the development of modern medicine, the health level of society has improved in terms of quantity, including increased average life expectancy and healthy life expectancy (Park, Kim, Jeong, & Cha, 2017). However, the

proportion of the disabled population increased to 2.51 million (4.9%) in 2016 (Statistics Korea, 2016). Among them, the number of people with intellectual disabilities is 195,000, thereby accounting for 7.8% of all disabled people (Statistics Korea, 2016). Once a person is diagnosed with intellectual disability, he or she will experience difficulties

in education, employment, everyday life, and use of convenience facilities due to the limitations in recognition and communication areas (Hardee & Fetters, 2017; K. Lee, Lee, & Song, 2016). Most of them are in the medical health-vulnerable class that needs assistance with daily life because of their limited range of activities as a result of the restrictions on physical activity and mental withdrawal (Kachouri et al., 2016; K. J. Lee, Lee, Shin, Shin, & Song, 2014). In 2017, the employment rate of people with disabilities in Korea is 36.5% (Statistics Korea, 2017a). In order to ensure a basic living standard, as well as maintain an independent daily life and physical activity, national, social, and family supports are necessary due to the difficulty in living an independent life and performing economic activities. According to the data of the National Statistical Office (Statistics Korea, 2017b), the most common exercises preferred by people with disabilities were walking and light running (40.7%). The purposes for the exercise were rehabilitation treatment (46.5%), health promotion (43.5%), and leisure (8.7%) in this order; and the effects of the exercise were physical enhancement (54.8%), rehabilitation treatment effect (14.7%), and stress relief (13.4%). As such, people with disabilities want to receive medical and rehabilitation services that focus on rehabilitation and health promotion. However, in reality, there is a lack of facilities that can accommodate people with intellectual disabilities and manage their health (Statistics Korea, 2017c). Even though there are physical activity programs for health management, most of them are one-time short-term programs. Therefore, continuous program development and application are necessary in order to manage the health and address the problems of secondary metabolic disorders in people with intellectual disabilities.

As people with intellectual disabilities encounter difficulties in participating and concentrating in physical activities (Kachouri et al., 2016; K. J. Lee et al., 2014), they experience reduction and shortage of physical activities (Hardee & Fetters, 2017; Y. C. Lee, 2014), as well as lack of muscular strength, coordination, and flexibility (Y. J. Kim, 2010; Oviedo, Guerra-Balic, Baynard, & Javierre, 2014). Furthermore, they are at a higher risk of having cardiovascular disease, as compared to people without disabilities (Elmahgoub et al., 2011). Regular exercise programs are recommended in order to reduce risk factors, such as obesity, serum lipids, hypertension, diabetes mellitus, stress, lack of exercise, smoking, and so on (Garcia-Villamizar, Dattilo, & Muela, 2017; Hardee & Fetters, 2017; K. Lee et al., 2016). Walking and light running preferred by people with intellectual disabilities are performed indoors and outdoors in daily life. However, these movements can lead to the risk of accidents due to physical incongruity and unnatural movements (Garcia-Villamizar et al., 2017; K. Lee et al., 2016). Moreover, walking is monotonous and it may not be appropriate as an

exercise method to improve one's body function for people with intellectual disabilities (Hardee & Fetters, 2017; K. J. Lee et al., 2014, 2016). Therefore, it is necessary to apply Tai Chi therapy which not only improves physical health index but also improves the body's flexibility and equilibrium sense and also helps to develop mental, social and physical abilities with rehabilitation treatment effect. Tai Chi therapy is designed for slow, gentle movements, so that people with intellectual disabilities, who cannot follow dynamic physical activities, can easily follow (Y. C. Lee, 2014). It is effective on physical flexibility and sense of balance; therefore, it also helps in preventing falls in people with intellectual disabilities who are at a higher accident risk due to their unnatural movements (Bubela, Sacharko, Chan, & Brady, 2017; Kachouri et al., 2016; K. Lee et al., 2016;). Additionally, it is a physical activity program that is beneficial to the rehabilitation treatment and physical function improvement of people with intellectual disabilities since it is helpful for the development of mental, social, and physical abilities, such as decrease in blood pressure, hyperlipidemia, and body mass index (BMI) (Chang, Lee, & Eom, 2014; Y. Kim, 2013; Salmoirago-Blotcher et al., 2017; Sun & Buys, 2015).

Most of the previous studies conducted on people with intellectual disabilities were correlational and cognitive research regarding their health status and life satisfaction (Park, 2007). However, it was difficult to find an experimental study that verified the application effect of applying Tai Chi therapy or combining a physical activity program for disabilities.

Therefore, the researcher wanted to help people with intellectual disabilities, who were accommodated in care facilities, to live a better life by obtaining rehabilitation treatment effects, as well as maintaining and promoting their physical health through Tai Chi therapy. In addition, this study was conducted in order to provide the basic data for the development of nursing intervention. The purpose of this study was to promote physical health of people with intellectual disabilities through Tai Chi therapy. The concrete aims of this study were to: (a) identify the general characteristics of study participants; (b) examine the effects of Tai Chi therapy on BMI and physical index among intellectual disabilities.

2 | METHODS

2.1 | Design and participants

A quasi-experimental study using a pretest-post-test control group, non-synchronized design was employed. The study participants were in total 104 people with intellectual disabilities (experimental group: $n = 67$, control group: $n = 37$) in two facilities in South Korea. The study sites were residence facilities for people with intellectual disabilities with facility life caregivers and guardians, and two facilities were

very similar in environmental surroundings. Study participants participated through convenience sampling into this study. During the coin toss, heads meant the subject becomes a participant of the experimental group in this study. Eligibility criteria included people with intellectual disabilities 20 years or older who agreed to take part in it, had the physical strength to participate and follow the Tai Chi therapy, and who were able to cooperate in measuring physical fitness and questionnaires. The exclusion criteria included persons with any disease diagnosed by a medical doctor. All participants completed the study, and there was no retention. No participants were accustomed to exercise.

Sample size adequacy ($N = 34$ for each group) using t test, G power 3.1 analysis software was estimated based on an alpha level of .05, medium effect size of 0.5, and power of 0.80 (Faul, Erdfelder, Lang, & Bunchner, 2007). Therefore, the sample size of this study was appropriate.

2.2 | Experimental intervention

The Tai Chi therapy used for the experimental intervention was the Sun style Tai Chi exercise, which consisted of warm-up exercises with six movements for 5 min, main exercise with 12 movements (six basic movements and six advanced movements) for 45 min, and finishing exercise (meditation) for 10 min. Tai Chi therapy was conducted twice a week for a total of 40 sessions for 5 months (1 hr each) by one professional instructor (Tai Chi leader) and one assistant instructor in the care facility where the subjects reside. The Tai Chi therapy was carried out during the daytime between lunch and dinner. The instructors who taught Tai Chi therapy are certified, and they have been educating and serving in the community for many years. For the consistency of the therapy, the instructors first confirmed the consistency of the Tai Chi therapy movements. The specific contents of Tai Chi therapy are as follows (Table 1).

1. Warm-up exercise (5 min). This stage consisted of turning the neck left and right, as well as tilting, turning the shoulder, stretching arms, spreading the legs to the side,

extending the Achilles tendon, turning the knees and ankles, and closing and opening the hand while walking lightly in this order.

2. Main exercise (45 min). Start with a relaxed mind. After gathering both heels to make them 90° , lightly clench your fists and place them on the seam of the pants. Slightly pull the chin inside while facing forward.
3. Finishing exercise (10 min). In this stage, thigh tapping, tension and relaxation, and respiration are performed in this order, and the subjects listen to music while lying on the floor with their eyes closed.

2.3 | Instruments for evaluation

A questionnaire was designed to measure general characteristics of study participants, BMI as degree of obesity, and physical index. Study participants' general characteristics were noted by researchers and consisted of age, gender, level of barriers, religion, economic status, job, and health status. This consisted of a total of seven items.

BMI was objectively measured by using the InBody 720 (Biospace, Seoul, Korea) as a physical measurement machine via bio-electrical impedance analysis (BIA). The reliability of the measuring device was checked by an expert in a hospital.

Physical index included systolic blood pressure, diastolic blood pressure, fasting blood glucose, cholesterol, high-density lipoprotein (HDL), and low-density lipoprotein (LDL). They were objectively measured by using the sphygmomanometer, diabetes meter, and blood sampler (Biospace, Seoul, Korea). The reliability and validity of the blood measuring device was checked by an expert in a hospital.

2.4 | Data collection

The data collection period of this study was from July 2016 to December 2016. After obtaining the Institutional Review Board (IRB) approval from K University for the study, the researcher visited the facility in order to request research permission from the care facility where the study subjects were residing. After receiving the research permission letter

TABLE 1 Contents of Tai Chi therapy

Step	Contents	Time (min)	Methods	Effect
Preparatory stage	Warm-up	5	Body to get rid of motion	Prevention of injury
Basic motion of Tai Chi	-Flexibility exercise-Strength exercise-Aerobic exercise	45	Subjects imitate their instructor's motions	Pain relief, fall prevention, blood and O_2 circulation, improvement of cardiopulmonary function and physical fitness
End	Meditation	10	Lie on the ground and then listen to music	Relaxation of tension, emotion stability

from the institution, the study subjects were selected. The purpose of this study, contents and method of experimental intervention, study procedure, questionnaire, measurement variables, and so on, were explained to the subjects, guardians, and legal representatives. The study was initiated after the subjects voluntarily provided their written informed consent.

On the first day of the program, the research team provided guidance on Tai Chi therapy with information on its effectiveness and efficacy, and physical activity was managed by creating a health handbook in order to induce motivation for program participation. As a reward, different success souvenirs were provided according to the achievement rate, as compared to the program goal. During the program, the health center staff, volunteers, and facility staff participated in the activities to prevent any physical injury to the subjects and to facilitate the program operation. For the control group, there was no treatment provided for the purpose of intervention, and the subjects were guided to lead the same daily life as before. Pretest and post-test were conducted by the research assistants (two nurses and three nursing students) in the care facility where the Tai Chi therapy was provided. The sociodemographic characteristics of the subjects were measured by using a self-report questionnaire, while the obesity index and physiological index (blood pressure, blood glucose, and hyperlipidemia) were measured by using the clinical indicator measurement method. The research assistants read the self-report questionnaire to the subjects on a one-to-one basis and requested them to fill out the questionnaire. Subjects with difficulty in understanding filled out the questionnaire with the help of the facility life caregivers and guardians who were living together with the subjects. All measures including the blood samples were taken before exercise as pretest and after exercise as post-test.

2.5 | Data analysis

The collected data were analyzed using the SPSS version 21.0 statistical software program. General characteristics of the study participants were analyzed using descriptive statistics with frequency, percentage, mean, and standard deviation. Homogeneity of general characteristics and study variables at pre-experimental intervention between the two groups were analyzed using χ^2 test or independent t test. The normality of the data were analyzed using Kolmogorov–Smirnov test. To examine and compare the effects of Tai Chi therapy, independent t test was used. A P value of less than .05 was considered statistically significant.

2.6 | Ethics consideration

In ethics considerations, approval for this study was obtained from the IRB committee at K University (Approval No. GU-

201606-HRa-01-01). The purpose and contents of the study, anonymity of the subjects, and information on confidentiality were explained, and a written informed consent form was obtained from the subjects and guardians who voluntarily wanted to participate in the study. The subjects were told that their study participation was voluntary, and they were allowed to withdraw their participation at any time during the study. In addition, there was no harm caused by their withdrawal in the middle of the study. The anonymity and confidentiality of the study were also explained to the subjects. The researchers received completed written consent forms from those who agreed to participate in the study.

3 | RESULTS

3.1 | General characteristics of study participants and homogeneity

Age in the experimental group was mean 32.33 years and mean 32.67 years in the control group. The primary gender was male (experimental: 58.0%, control: 70.6%). For the level of barriers, middle level was 49.7% in the experimental group, and 54.5% in the control group. Most participants were religious (experimental: 80.0%, control: 81.2%), and had jobs (experimental: 61.5%, control: 58.1%). For health status, participants reported that good level or over was 46.7% in the experimental group, and 43.7% in the control group. For BMI, most participants were slightly obese (experimental: 74.1%, control: 81.0%). As for the general characteristics of the experimental and control groups, as well as the study variables before the experiment, there were no group differences at baseline at a statistical significance level of $P < .05$ (Tables 2 and 3).

3.2 | Comparisons on BMI and physical index between the two groups

There were statistically significant differences on fasting blood glucose ($t = 4.351$, $P < .001$) and HDL ($t = -2.052$, $P = .043$) in physical index between the two groups. Between the two groups, there were no significant differences in other study variables (Table 4).

4 | DISCUSSION

The study was conducted in order to enhance the physical activity and improve the health status of people with intellectual disabilities, who are living in a facility, through a Tai Chi therapy program. The study results showed that the Tai Chi therapy applied to people with intellectual disabilities improved some of their physiological indices (fasting blood glucose and HDL). It is difficult to compare the results of

TABLE 2 General characteristics of study participants and homogeneity (N = 104)

Characteristics	Items	Experimental group (n = 67) n (%) or mean \pm SD	Control group (n = 37) n (%) or mean \pm SD	χ^2 or t	P
Age, years		32.33 \pm 8.25	32.67 \pm 7.14	2.172	.330
Gender	Male	39 (58.0)	26 (70.6)	0.113	.117
	Female	28 (42.0)	11 (29.4)		
Level of barriers	Severe	19 (27.1)	9 (26.1)	2.421	.303
	Middle	34 (49.7)	20 (54.5)		
	Low	14 (21.2)	7 (19.4)		
Religion	Yes	54 (80.0)	30 (81.2)	2.482	.654
	No	13 (20.0)	7 (18.8)		
Economic state	High	16 (23.2)	11 (30.3)	3.872	.421
	Middle	30 (45.4)	16 (42.4)		
	Lower	21 (31.4)	10 (27.3)		
Job	Yes	41 (61.5)	21 (58.1)	0.821	.373
	No	26 (38.5)	16 (41.9)		
Health status	\leq Bad	11 (16.6)	7 (18.8)	7.842	.094
	Average	25 (36.7)	14 (37.5)		
	\geq Good	31 (46.7)	16 (43.7)		
Body mass index	Normal (<23%)	11 (16.0)	7 (19.0)	2.273	.322
	Slight obesity (23–29%)	50 (74.1)	30 (81.0)		
	Moderate obesity (30–49%)	6 (9.9)	-		

the present study since there are no previous studies that have investigated the effects on obesity and physiological index by applying Tai Chi therapy for people with intellectual disabilities. However, these results supported a previous study having reported that Tai Chi therapy induces a relaxation reaction that improves insulin resistance and leads to a positive change in blood glucose metabolism (Hwang, Ahn, & Song, 2010; Sun & Buys, 2015), and a study that showed the effects on glycated hemoglobin reduction (Hwang et al., 2010). In addition, the present study

supported a previous study that showed its efficacy in reducing the incidence of cardiovascular disease (Salmoirago-Blotcher et al., 2017). The reason seems to be that Tai Chi therapy involves movements that are accompanied by abdominal breathing, thereby improving circulation function (Kim, Eke Dogra, Al-Sahab, & Tamim, 2014; Salmoirago-Blotcher et al., 2017). It is also a form of exercise that promotes peripheral microcirculation as a low-intensity exercise with 40% to 45% oxygen consumption (Fontana, 2000; Pan, Kairy, Corriveau, & Tousignant, 2017). However, the

TABLE 3 Homogeneity test of study variables (N = 104)

Variables		Experimental group (n = 67) mean \pm SD	Control group (n = 37) mean \pm SD	t	P
Body mass index		24.38 \pm 4.25	22.29 \pm 2.65	2.150	.054
Physical index	Systolic blood pressure (mmHg)	123.12 \pm 21.03	116.38 \pm 16.86	1.360	.177
	Diastolic blood pressure (mmHg)	81.86 \pm 11.89	74.14 \pm 11.74	2.668	.102
	Fasting blood glucose (mg/dL)	93.15 \pm 9.20	92.00 \pm 9.64	0.491	.627
	Cholesterol (mg/dL)	160.54 \pm 32.49	153.81 \pm 24.47	1.046	.302
	High-density lipoprotein (mg/dL)	39.94 \pm 10.11	45.95 \pm 11.13	-1.046	.302
	Low-density lipoprotein (mg/dL)	99.76 \pm 30.86	87.21 \pm 25.00	1.950	.059

TABLE 4 Comparisons on body mass index (BMI) and physical index between two groups (N = 104)

Variables		Groups	Pretest	Post-test	Difference	<i>t</i>	<i>P</i>
			Mean \pm SD	Mean \pm SD	Mean \pm SD		
BMI		Exp.	24.38 \pm 4.25	24.97 \pm 4.82	0.62 \pm 2.85	-1.425	.158
		Cont.	22.29 \pm 2.65	22.80 \pm 4.21	0.55 \pm 0.74		
Physical index	Systolic blood pressure (mmHg)	Exp.	123.12 \pm 21.03	120.55 \pm 14.86	-3.18 \pm 14.53	1.966	.052
		Cont.	116.38 \pm 16.86	114.59 \pm 12.57	-1.25 \pm 8.50		
	Diastolic blood pressure (mmHg)	Exp.	81.86 \pm 11.89	79.08 \pm 11.57	-2.27 \pm 9.60	0.781	.437
		Cont.	74.14 \pm 11.74	77.30 \pm 13.12	5.30 \pm 12.20		
	Fasting blood glucose (mg/dL)	Exp.	93.15 \pm 9.20	90.85 \pm 7.85	-3.27 \pm 10.94	4.351	<.001*
		Cont.	92.00 \pm 9.64	91.93 \pm 8.72	-0.07 \pm 0.92		
	Cholesterol (mg/dL)	Exp.	160.54 \pm 32.49	161.67 \pm 37.85	1.13 \pm 5.36	-0.932	.354
		Cont.	153.81 \pm 24.47	154.56 \pm 26.31	0.75 \pm 1.84		
	High-density lipoprotein (mg/dL)	Exp.	39.94 \pm 10.11	42.12 \pm 14.89	2.18 \pm 4.78	-2.052	.043*
		Cont.	45.95 \pm 11.13	46.19 \pm 12.05	0.24 \pm 0.92		
	Low-density lipoprotein (mg/dL)	Exp.	99.76 \pm 30.86	98.99 \pm 37.49	0.77 \pm 6.63	-0.523	.602
		Cont.	87.21 \pm 25.00	90.59 \pm 22.17	3.38 \pm 2.83		

Abbreviations: Cont., control group ($n = 37$); Exp., experimental group ($n = 67$).

* $P < .05$.

present study did not fully support the previous study (Chang et al., 2014), which reported that Tai Chi was effective in body composition (e.g., BMI), blood pressure, and serum lipids, except for LDL. This is because the subjects of Chang et al. (2014) were middle-aged women, while the subjects of the present study were people with intellectual disabilities who lacked persistent concentration and had a tendency to perform passive activities rather than regular and active exercises by themselves, so intensive exercises were not enough.

In this study, the systolic and diastolic blood pressures were reduced in the experimental group by 3 and 2 mmHg, respectively, as compared to the control group. However, they were not statistically significant. This result could not support the previous studies (Ko, Tsang, & Chan, 2006; Sun & Buys, 2015) that reported the blood pressure decrease effect of Tai Chi therapy because the reported result values were lower than that of the seventh report of the US Joint National Committee (JNC), which suggested that regular aerobic exercise can reduce blood pressure by 4–9 mmHg (Chobanian et al., 2003). This seems to be attributed to the fact that the study subjects were intellectually disabled people with difficulties in persistent concentration and lack of muscular strength and coordination (Kachouri et al., 2016; K. Lee et al., 2016). According to the study conducted by Song (2006), low-intensity exercise requires at least 12 weeks of application and four or more times of exercise. However, in the present study the experimental treatment

was conducted twice a week for 5 months for the convenience of the subjects. It is thought that if a more intensive exercise had been provided more than four times a week, we might have obtained statistically significant results. Although the decreases in systolic and diastolic blood pressures were not statistically significant, improving the hypertension treatment rate and control rate, which are the most important risk factors for the morbidity of heart disease and mortality in patients with cerebrovascular disease, will greatly contribute to the reduction in the incidence of cardiovascular disease (Pan et al., 2017; Salmoirago-Blotcher et al., 2017). Additionally, it may be able to support some of the previous study results (Salmoirago-Blotcher et al., 2017), thereby showing that it is important to control the risk factors for cardiovascular disease that can be improved through persistent blood pressure control.

Among the blood lipid concentrations, cholesterol and LDL levels did not decrease in this study. This result shows that for people with intellectual disabilities, a more intensive exercise program should be persistently applied, as compared to the exercise program for the general public.

4.1 | Implications and limitations

Based on these findings of this study, when applying Tai Chi therapy to people with intellectual disabilities, it is necessary to provide a program that is designed to show exercise effects by increasing the duration and frequency in

order to increase the exercise intensity, and inducing interest to increase concentration. Also, in order to maintain the health status of intellectually disabled people with limited cognitive growth, relatively lower exercise participation rate than that of the general public due to their physical and mental limitations, and significantly reduced physical fitness (Garcia-Villamizar et al., 2017; K. J. Lee et al., 2014), the development of programs that take into account the difficulties in intensive and dynamic physical activities is required, and various supports include health policies should be continuously provided for a long duration, so that they could voluntarily initiate their physical activities. As a policy implication, a government agency may formulate a health policy in which the facilities can introduce exercise programs like Tai Chi therapy for the health of people with intellectual disabilities throughout the country. For further studies, Tai Chi therapy programs, in which various subjects, places, and variables are used, should be developed based on the effects proven in this study. In addition, experimental studies to verify the application effect are deemed necessary.

The generalizability of this study's results is limited because the study participants were recruited from those with intellectual disabilities in two facilities in South Korea, which limited the characteristics of the resulting data. Therefore, a replication of this study using larger samples drawn from both the same and different regions of the country is needed to confirm the generalizability of the study results. However, the main aim of this study was to provide information on which to build future investigations.

5 | CONCLUSION

The results of this study demonstrated that participation in Tai Chi therapy is effective in decreasing fasting blood glucose levels and increasing HDL levels in patients with intellectual disabilities. This study is expected to be used as experimental evidence of intervention for the improvement of the physical activity of people with intellectual disabilities, as Tai Chi therapy promoted some improvements in their physical status, such as blood glucose and HDL levels. However, more differentiated and intensive programs should be applied for people with intellectual disabilities, as compared to the intensity that is applied to the general public. Continuous attention and research are needed in order to improve health status of intellectual disabilities.

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CONFLICT OF INTERESTS

The authors have no conflict of interests.

AUTHOR CONTRIBUTIONS

N.H.C., G.E.J., Y.C., and S.R.S. contributed to the conception and design of this study; N.H.C. and S.R.S. performed the statistical analysis and drafted the manuscript; and N.H.C., G.E.J., Y.C., and S.R.S. critically reviewed the manuscript and supervised the whole study process. All authors read and approved the final manuscript.

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