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PROMOTING PSYCHOLOGICAL AND HEALTH STATUS OF THE ELDERLY: THE UNDERLYING MECHANISMS OF CHIN-DON THERAPY

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ANNOUNCEMENT

- The 2019 International Conference on Quality of Life was held at Kyoto Pharmaceutical University from Sept 28-29, 2019. Further information can be found at <http://as4qol.org/icqol/2019/>
- We have moved to continuous publication. Beginning January 2019 the editing committee has decided to adopt a continuous publishing model for Journal publication. Individual articles will be released online as they become ready, allowing a steady stream of informative quality articles. We will also be moving to a calendar year issue cycle. In traditional terms, each volume will encompass a single year and consist of a single issue. Publishing on a just-in-time basis allows authors to present their results in a timely fashion, and our readers, students, and colleagues to access our content and cite articles more quickly and free from the restrictions of a predefined timetable. As a result of these changes, the look and style, as well as the function, of the Journal will be different, and hopefully improved.
- The 2018 International Meeting on Quality of Life was held recently. Proceedings as well as photos and other information can be found at <http://as4qol.org/icqol/2018/>

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Promoting Psychological and Health Status of the Elderly: The Underlying Mechanisms of Chin-Don Therapy

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Abstract

Chin-Don (CD) performance – a kind of musical performance for common people in Japan during the Edo Period – has been proven useful for health-care promotion and healing, and was therefore employed as CD therapy (CDT) in a series of studies. Since CDT induces favorable outcomes in three elderly subjects, we further investigated the benefits of CDT in promoting quality-of-life in the cognitively impaired elderly using objective approaches: i) measuring salivary cortisol and immunoglobulin-A; ii) self-assessment of mood, emotion, and behavior using a face-scale; (iii) monitoring blood levels of neurotransmitters such as adrenalin (AD), noradrenalin (NA), and dopamine (DP) as well as the stress-related hormone cortisol (CT) and β -endorphin (BE); and (iv) monitoring stress-related CT, as well as immunodefense system-related BE and natural killer (NK) cell activity. Our studies focus on endogenous factors closely related to humor, laughter, stress, emotion, depression, joy, movement, and other apparent physiological responses such as being more alert and aroused (such as AD, NA, CT, BE). CDT works effectively in improving mood (emotional and psychological states) for the elderly. The significant blood CT level decreases in CDT patents may have due to less stress during CDT exposure, as CT is associated with elevated stress input. We did not measure the effect of immunity by CT decrease, as the effect would be transient and short-lived. Of the local vs global categories of BE function, the latter function is more relevant with CDT in decreasing bodily stress and maintaining homeostasis (e.g. in pain management, reward effects, and behavioral stability), providing enthusiastic participation and satisfactory post-event emotions and/or behavior in the CD-induced dancing. All in all, CDT induces favorable de-stressing effects, euphoric reliefs, reduction in pain and/or physical handicaps experienced by the elderly participants. These favorable psychological and physiological responses could be explained via relevant objective monitoring of blood indexes (although more endogenous factors need to be monitored), thus advocating the useful effects of CDT.

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1. Chin-Don Therapy (CDT)

Music is wonderful, and it has been used for promoting psychological and healthcare needs (<https://www.healthline.com/health/sound-healing>). Various non-chemical approaches of entertainment and methods have been employed in recent years: laughter therapy via group work or in a community setting has especially scored significantly favorable outcomes.¹⁻¹² Chin-Don (CD) performance – a kind of musical performance for event promotion and festivals in Japan during the Edo Period¹³ – has been proven useful for healthcare promotion and healing, and was therefore employed as CD therapy (CDT) in a series of studies, ranging from observational assessments of facial/physical expressions to objective measurements of changes in blood levels of relevant endogenous substances in the human body. Briefly, the ‘chin’ and ‘don’ are sounded respectively by beating a gong-like instrument and a drum with a stick to produce a rhythmic musical flow of 3 (don x 3) + 7 (chin x 7) beats on a repeated basis by colorfully dressed performers who move and dance in circles.⁸ In studies using other methods involving humor/laughter, music, and alternative medicine, the results have been known to favorably improve depression and dementia/Alzheimer’s disease,^{1,3,5,8,9} elevate emotion⁹⁻¹² and promote the immunodefense system^{7,14,15} while attenuating stress in humans.^{6,11,12}

Japan boasts of the highest longevity in the world; however, increased longevity comes with imposition of multifaceted and demanding issues on quality-of-life (QoL) for the elderly per se and relevant health authorities. Apart from oral intake of synthetic compounds and natural supplements, the use of music, including CD performance, has indicated beneficial QoL outcomes.

Since CDT induces favorable outcomes (psychological and health statuses) in three elderly subjects in our first trial to see if it worked on elderly to improve their QoL,⁸ we have further investigated the benefits of CDT in promoting QoL in the cognitively impaired elderly using objective approaches in human studies: i) measuring salivary cortisol (sCT) and immunoglobulin-A (IgA); ii) self-assessment of mood, emotion, and behavior using a face-scale;¹⁶ (iii) monitoring blood levels of neurotransmitters such as adrenalin (AD), noradrenalin (NA), and dopamine (DP);⁹ and furthermore, (iv) monitoring stress-related hormonal factor cortisol (CT), as well as immunodefense system-related peptide beta-endorphin (BE) and natural killer (NK) cell activity.^{11,17}

1.1 Effects of CDT on psychological and health status in the cognitively impaired elderly (CIE): sCT and IgA monitoring

By employing CDT using drum, trumpet, flute, and other Asian musical instruments accompanied by humorous gestures, singing, and dancing with or without occasional interactive participation of study-participants in motor activity with performers, the results have shown to yield psychologically positive effects of CDT (viz., triggering of smiles/laughter, improved mood, and better interpersonal relationships) in elderly subjects. Similar CDT stimuli given to 11 CIE patients do not elicit significant positive effects in systolic/diastolic blood pressure, pulse rate and salivary parameters (sCT, IgA), although healthy reference subjects show significant increases in sCT and IgA levels in saliva.¹⁶ The null effects observed in CIE subjects are probably due to the inability of CIE patients with deficient mental status to respond to CDT although the exposure period of 30-min is long enough to monitor mood expressions.⁹ As for sudden changes of salivary secretions (sCT, IgA), the 30-min may be too long a period for monitoring these indexes. CDT may not have elicited useful outcomes in CIE patients (due to deficient mental status of patients to cope with, and/or improper parameters and time-monitoring in the experimental set-up); however, it manifests significant favorable stress-coping responses in healthy reference subjects based on findings in hormonal factors such as cortisol and IgA levels in salivary samples.¹¹

1.2 Self-assessment of mood, emotion, and behavior using a face-scale and HRQOL-SF8¹⁶

In another study involving 30 physically independent elderly subjects (based on their mean Barthel index; <http://www.strokecenter.org/wp-content/uploads/2011/08/barthel>), 18 (age range; 70-89 yr; male: 1; female: 17) were subjected to CDT, while 12 (age range: 60-89 yr; male: 3, female 9) served as controls. Subjects are assessed using 2 methods: (A) assessed using a face-scale for self-assessment of mood after 30-min CDT stimuli; and (B) assessment with HROQOL-SF8, where scores based on the 8-item questionnaire 1 week before and after CDT exposure are compared. Additionally, those with MMSE scores of <17, or disagreed to participate in the study, are omitted from the investigation.

In method A, CDT-exposed subjects indicate significantly joyful mood compared to non-CDT subjects. Additionally, the former group shows sweating, heavy breathing, dilated pupils with smiles/laughter and satisfaction of having had fun (signs from a physical exercise). However, in method B, scores on physical, emotional and behavioral changes, as well as psychological health statuses of CDT-exposed subjects are not significantly different from the non-CDT subjects, although the former shows apparent facial and behavioral gestures of happiness and ‘having had fun’. Factors influencing positive CDT effects are measurable within 30 min after CDT exposure; however, effects would not be able to be monitored as they would not last long enough in blood after CDT-exposure (e.g. day 7 or earlier).

1.3 Effects of CDT on blood neurotransmitter levels: Outcomes in emotional and behavioral aspects in elderly subjects

Venturing further with an objective method assessing certain blood indexes, such as adrenalin (AD), noradrenalin (NA), and dopamine (DP) in humans,⁹ the favorable results provide better understanding of the physiological mechanisms involved. These blood indexes are selected because of their relationships with physical and mental diseases affecting the QoL of human patients, especially the elderly. Patients in the CDT group participate actively in the CD performance, they appear to have sweated profusely, breathed heavily, and felt relieved and joyful with smiles/laughter after CDT exposure. Accordingly, the blood AD ($p < 0.008$) and NA ($p < 0.002$) but not DP levels show significant increases; however, those in the non-CDT group do not indicate any change.

1.4 Relationships of CDT with emotional, behavioral, and immunodefense system in the elderly

As CDT indicate relationships with emotional, behavioral, and immunodefense system in the elderly, immunodefense-related neurotransmitters/hormone, such as BE, NK cell activity, and cortisol (CT) in blood before and after CDT have been studied to assess their effects on the elderly. The aforesaid indexes, previously documented to associate with emotional⁹⁻¹² and immunodefense systems^{7,14,15} affecting the QoL of humans (especially the elderly), have been focused to complement study of blood level variations of AD, NA, and DP to provide a global understanding of the roles of these transmitters/hormones in improving elderly human QoL. In studies using other methods involving humor/laughter, music, and alternative medicine, the results have known to favorably improve depression and dementia/Alzheimer’s disease,^{1,3,5,8,9} elevate emotion⁹⁻¹² and promote the immunodefense system^{7,14,15} while attenuating stress in humans.^{6,11,12}

Blood levels of CT ($p < 0.004$) and BE ($p < 0.005$) in the CDT group are significantly elevated after CDT (Table 1), while the non-CDT group does not show any marked changes in blood CT or BE levels.¹¹ As for NK cell activity levels, marked changes ($p = 0.06$) in the CDT but not the non-CDT group have been noted.¹⁷ Patients are jubilant and joyful, and appear to participate positively in dancing with rhythmic steps and laughter (Table 2). They pupils are dilated, breathing heavily, sweating, and physically exhausted, but they are otherwise in a joyful mood, showing happiness and satisfaction with smiles/laughter (Table 2).

2. The underlying mechanisms of CDT effects

CDT-induced changes in blood levels of AD, NA, CT, BE, and NK cell activity affect certain emotional and physiological behaviors of the elderly (summarized in Tables 1 and 2).

Our series of studies focus on endogenous factors closely related to humor, laughter, stress, emotion, depression, joy, movement, and other apparent physiological responses such as being more alert and aroused. In short, increased blood levels in AD and NA – associated with increases in heart rate, myocardial contractility, respiratory rate, bronchodilation, vasodilation/vasoconstriction, muscle contraction, etc. – are needed to cope with the results (profuse sweating, heavy breathing, and joy/relief with smiles/laughter).

Table 1. Neurotransmitters AD and NA and peptide BE and hormone CT scored significant increases in blood levels, while NK cell activity, albeit elevated, indicates increased tendency ($p = 0.06$), and DP is not significantly affected by CDT exposure.

AD	NA	DP	BE	CT	NK cell activity
$p < 0.008$	$p < 0.002$	-	$p < 0.035$	$p < 0.004$	$p = 0.06$ (significance tendency)

Table 2 Physiological and emotional responses to CDT-induced changes in blood levels of various neurotransmitters and endocrine factors described in Table 1.

Blood Level Change	Physiological and Emotional Behaviors
AD increased (p<0.008) NA increased (p<0.002)	<ol style="list-style-type: none"> 1) Increase: blood flow, heart rate, cardiac output, myocardial contractility, respiratory rate, blood sugar level 2) Bronchodilation, vasodilation/vasoconstriction, muscle contraction 3) Profuse sweating, heavy breathing, joy/relief with smiles/laughter 4) Induction of the fear-fight-flight (triple-F) response 5) Pupil dilation, increases arousal and alertness, physical agitation 6) Improve depression/dementia 7) Attenuate stress in psychologically affected patients 8) Trigger specific defense mechanism: positive emotions overcomes undesirable negative emotions in stressful situations 9) Mood improvement
CT increased (p<0.004)	<ol style="list-style-type: none"> 1) Associates with elevated stress input: effect transient and short-lived 2) Triggers the hypothalamus-pituitary-adrenal system, and NA-associated pathways - including the sympathetic nervous system and the locus coeruleus systems. 3) Dancing with rhythmic beats with the 'fright-fight-flight' response (heavy breathing, sweating, dilated pupils, etc.) while forgetting unhappy or depressive emotions (joyful mood).
BE increased (p<0.035) DP (not significant)	<ol style="list-style-type: none"> 1) Attenuate stress and maintain homeostasis 2) Associate with hunger, thrill, pain, maternal care, sexual behavior, and reward recognition 3) Trigger global functions, decreasing bodily stress and maintaining homeostasis (e.g. in pain management, reward effects, and behavioral stability), providing enthusiastic participation and satisfactory post-event emotions and/or behavior (e.g. dancing) 4) Induce euphoric feel or "runners' high". yielding euphoria and analgesic effects 5) Release γ-aminobutyric acid (GABA), a neurotransmitter that inhibits dopamine (DP) release
NK cell activity increased (p<0.06; with tendency)	<ol style="list-style-type: none"> 1) Enhances immunodefense system 2) Induced by laughter and joyful feelings 3) Miscellaneous

ter) after CDT exposure (Tables 1, 2). Furthermore, AD and NA – related with induction of the fear-fight-flight (triple-F) response – are also associated with increased blood flow to muscles, cardiac output, pupil dilation, and blood sugar to cope with those effects elicited by CDT (Table 2). NA in the brain increases arousal and alertness: signs which are apparent in CDT-exposed patients. Therefore, CDT elicits neurotransmitters relevant to the CDT-induced physical and mental outcomes. Patients participate actively in the CDT show physical agitation, enlarged pupils, profuse sweating, heavy breathing, and joy/relief with smiles/laughter compared to non-CDT patients. The CDT group indicate significantly increased blood levels of AD (p<0.008) and NA (p<0.002) but not DP when compared with the non-CDT group. Our findings have demonstrated that CDT can improve depression and dementia and therefore promoting QoL^{8,9} as well as attenuating stress^{11,16} in psychologically affected patients via humor, laughter and relevant physical activity (Table 1, 2). Accordingly, CDT-induced effects may manifest as a specific defense mechanism where positive emotions can overcome the undesirable negative emotions involved in stressful situations.¹⁶ CDT evokes smiles/laughter and improves mood to yield useful effects with positive psychological and neuro-

logical outcomes via retrieval of fond memories of past events and experiences of three elderly Japanese cases.⁸ Blood level elevations in AD and NA (Table 1) account for relevant physiological and psychological responses observed (Table 2).⁹ CDT findings therefore reconfirm that this therapy works effectively in improving mood (emotional and psychological states) for the elderly. Although CDT may work for only those who have previously been exposed to CD performance/music (Japanese participants in this study) when young or during their childhood, a recent study¹⁶ using young Japanese subjects (<60 yr) proved otherwise. Unless proven, it may be premature to say that CDT works for other nationalities.

Of the blood indexes investigated, we first focused on CT, which is closely associated with stress. Stress is closely associated with endogenous releases of steroid hormones, such as CT, in the living system. Therefore, the significant ($p < 0.004$) blood CT level decreases in CDT patients may have due to less stress during CDT exposure, as CT is associated with elevated stress input (Table 2). We did not measure the effect of immunity by CT decrease, as the effect would be transient and short-lived.

Physiologically, stress is defined as a situation where the living system is disturbed to threaten the stability and functions of the body.¹⁷ Stress consistently influences the body system via the following: 1) the hypothalamus-pituitary-adrenal system, and 2) the NA-associated pathways - including the sympathetic nervous system and the locus coeruleus system (Table 2).^{18,19} Using CDT, we have found significant increases of AD and NA levels in blood of participants subjected to CDT (Table 1), with typical physiological responses manifesting the above systems 1) and 2).⁹ We have further reconfirmed the destressing effect of CDT by observing significant ($p < 0.004$) decreases in blood CT levels.^{11,17} In other words, patients are actively engaging in dancing with rhythmic beats with the 'fright-fight-flight' response (heavy breathing, sweating, dilated pupils, etc.) while forgetting unhappy or depressive emotions (joyful mood).^{8,9,16} The effects of AD- and ND-induced responses with apparent happy expressions⁹ most likely persist from during and after the 30-min CDT (time when blood was sampled for analysis). In our studies, under certain stressful conditions (e.g. CD music, aggressive behavior of other patients, etc.), the body systems of patients vary production of CT, AD, and NA in response to such stressors. These trigger an increased heart rate, heightened muscle preparedness, sweating, and alertness in the CDT group (Table 2). All these factors improve the ability to respond to a challenging situation we witnessed in this study.

β -endorphin, an endogenous opioid neuropeptide and peptide hormone,²⁰⁻²⁹ is associated with hunger, excitement, pain, maternal care, sexual behavior, and reward recognition. In the broadest perspective, β -endorphin is primarily used in the living system to attenuate stress and maintain homeostasis.^{23,25} Of the local vs global categories of function, the latter function is more relevant with CDT in decreasing body stress and maintaining homeostasis (e.g. in pain management, reward effects, and behavioral stability), providing enthusiastic participation and satisfactory post-event emotions and/or behavior in the CD-induced dancing.

CD-induced dancing is a form of exercise: it could be much more joyful to some when compared to mere physical exercise. β -endorphins are released in response to exercises have been documented in the 1980s,²¹ and induces euphoric feel or "runners' high".²² With regards to significant ($p < 0.005$) BE increases, patients could have felt a certain degree of euphoria in joining the dancing with nostalgic rhythmic CD music in the background. Despite physical difficulty and pain in some participants, they participate in the dancing, and they appear to have forgotten about their pain after the dancing (Table 2). This is probably due to the significant release of β -endorphin, because this opioid neuropeptide has a high affinity for and persistent effect on μ -opioid receptors (a receptor that morphine binds selectively),²⁴ yielding euphoria and analgesic effects in the CDT patients in the present and previous^{9,16} investigations, although we did not monitor pain and emotional scores in patients. It is intriguing to note that β -endorphin has 18- to 33-fold the analgesic potency of morphine²⁵ (albeit species-dependent).²⁶ The analgesic mechanism most probably involves β -endorphin binding to opioid receptors in the dorsal root of the spinal cord to inhibit onsite release substance P, thus reducing pain impulses relayed to the brain.^{27,28} The hypothalamus responds to the pain impulse by releasing β -endorphin through the periaqueductal grey network, which acts to release γ -aminobutyric acid (GABA), a neurotransmitter that inhibits dopamine (DP) release.^{27,29} This GABA-suppressing effect on DP may have prevented significant release of DP despite elevated physical activity performed by participants (Table 2).⁹

Approaches to influence the psychological and physiological perspectives of the body system have been adopted according to limitations of acoustic, visual, and cognitive abilities of the elderly. The effect

of laughter on recovery of a patient suffering from connective tissue disease has first been documented in 1976.³⁰ According to Itami et al.¹⁴ (1994), two Japanese breast-cancer patients have indicated elevated NK cell activity after enjoying stand-up comedies and comedian shows. Moreover, rheumatism-arthritis patients show attenuated interleukin-6 (IL-6) levels with significant decrease in pain scores after listening to comic stories told by professional storytellers.¹⁰ Furthermore, patients suffering from atopic dermatitis experience significantly lower wheal and erythema reactions when they are exposed to comedian-videos (comic-videos).³¹ Therefore, certain cell activities (such as that of NK cells)^{14,32,33} induced by laughter and joyful feelings of stand-up comedian shows, comic-videos, and CDT may have attenuated unwanted chemical/peptide release in the human body to yield useful immunity-related outcomes. The elderly patients in our study express joyful mood with transient favorable emotional and physical improvements (although reflected by a tendency ($p < 0.06$) for the NK cell activity level to almost score statistical significance (Table 2)).¹⁷

Although we have attempted to complement previously monitored endogenous indexes with additional parameters, there are other important indexes that we have not been able to monitor in our studies. With emotional behaviors and physical responses in tandem to CDT administrations, changes in blood levels of AD, NA, DP, CT, BE, and NK cell activity in the studies have been monitored. As far as we know, endogenous data in our studies are the first to account for the CDT-induced emotional and physical activities. All in all, CDT induces favorable de-stressing effects, euphoric reliefs, reduction in pain and/or physical handicaps experienced by the elderly participants. These favorable psychological and physiological responses are accountable with relevant objective monitoring of blood indexes, thus advocating the useful effects of CDT.

CDT improves emotional stress and physical performance (and probably the immunodefense system) of the elderly: viz., the favorable outcomes synchronize well with changes in blood levels of CT, AD, NA, and BE (and probably NK cell activity). Significant changes in blood AD, NA and CT levels have been registered with smiles/laughter of participants, while marked increased blood AD, NA, BE levels coincide well with elevated physical activity of slightly physically handicapped patients without complaining of pain or discomfort during and after CDT (Table 2). Although immunodefense system-related parameters have not been monitored, a statistical tendency ($p = 0.06$) in increasing blood NK cell activity levels has been noted (Table 1).¹⁷

There are still other endogenous factors that need to be investigated to clarify the complete effects of CDT. The roles of neurotransmitters such as serotonin and other neuropeptides such as enkephalins, etc. have yet to be pursued to fully understand the global mechanisms involved in CDT.

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