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# 思覺失調症個案運動健康效益及參與影響因子—質性研究

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## 摘要

**背景及目的：**文獻對於運動訓練對於思覺失調症個案的健康效益，大都著重在體適能和精神症狀，對其它健康面向瞭解有限。再者，目前對其參與運動方案的主觀經驗瞭解欠佳，不利發展適合方案。本研究目的：(一)了解思覺失調症個案對運動的健康效益面向；(二)探討參與規律結構化運動的阻礙與促進因子。

**方法：**參與者被隨機分派到伸展操組及有氧運動組(跑步機運動)。完成 3 個月的結構化運動方案訓練後，兩組進行各別的焦點團體，運用內容分析法進行資料分析。

**結果：**共進行 7 次焦點團體，合計 33 位參與者。參與者在健康效益有較明顯之感受，包含活力增加、體重減輕、睡眠品質改善、動作靈活度提升、情緒穩定度增加、自信心增加、專注力提升、生活較有規律性、社交主動性增加、參與事物動機增加及健康促進概念的建立。探討相關阻礙與促進因子有：專業人員陪同、實質獎勵、意志力、團體規範遵從度為參與者運動的助力；體力負荷較大、初期身體出現痠痛不適、運動內容單調、主動性低為維持規律運動的阻力。

**結論：**有氧運動或伸展操讓思覺失調症個案自覺能改善身心健康，所發現的促進及阻礙因子可助於發展思覺失調症個案的運動方案。未來可以採用量性研究來檢視這些主觀的運動健康效益，強化實證依據。

**關鍵字：**健康促進，精神疾病，運動參與，身體活動

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# 前言

思覺失調症(schizophrenia)個案受疾病負性症狀造成有動機低落、整體活動量低，且容易因服用抗精神病藥導致肥胖及罹患新陳代謝疾病，進而影響生活品質(Allison et al., 2009)。因此，如何協助思覺失調症個案提升健康維護情形及生活品質是近年來從事精神醫療及復健專業人員所關心與重視。增加體適能活動參與為重要的健康促進相關措施之一。根據美國衛生及服務部門(The U.S. Department of Health and Human Services) 歸納運動與健康方面的研究顯示，規律運動除了可以促進心肺耐力、預防心血管疾病、高血壓、預防肥胖等的發生，有氧運動還能改善憂鬱情形、睡眠品質及生活品質。美國運動醫學會與美國心臟學會提出成年人要獲得運動所帶來大量的健康效益，必須達到的活動量為每週 150 分鐘中等強度的有氧運動可有效達到上述效益(Haskell et al., 2007)。

從職能治療的觀點來看，運動對於思覺失調症個案是一個重要的職能活動。在職能治療執業架構：範疇與過程(The Occupational Therapy Practice Framework: Domain and Process)中，可以發現健康管理與維持是屬於一項重要的工具性日常生活活動，其中包括運動參與的健康促進行為(American Occupational Therapy Association, 2014)。陸續有研究探討運動對思覺失調症個案的健康效益。透過系統性回顧發現身體活動可以改善思覺失調症的自我勝任感、社交意願及安適感(Holley, 2011)。研究發現 16 週的跑步機行走訓練可降低個案的體脂肪及身體質量指數值(body mass index) (Beebe et al., 2005)。另外，10 週的有氧運動訓練（每周 3 次，每次 40 分鐘）可以改善思覺失調症個案後期精神症狀及生活品質(Acil, Dogan, & Dogan, 2008)。一項研究比較為期 6 個月的運動訓練（每周兩次，每次 1 小時肌力訓練）與一般職能治療介入（每周兩次，每次 1 小時閱讀或電腦等活動），結果顯示運動訓練對思覺失調症個案正性症狀及憂鬱情形有顯著進步(Scheewe, 2012)。另外，有對比瑜珈與有氧運動的初期研究發現，此兩種運動類型皆能有效降低焦慮與壓力並能提升主觀幸福感(Vancampfort et al., 2011)。綜合上述研究可瞭解初步證據支持運動對於思覺失調症個案可帶來不同層面的健康效益，但過去有關思覺失調症個案的研究大都以量性研究取向，並著重在體適能和精神症狀的評量，對

於其他面向的探討較為有限，如心理社會功能的改變。鑒於運動可以產生多種健康效果(U.S. Department of Health and Human Services, 2008)，透過質性研究取向來探討運動對於此臨床族群可能的健康效益，或許可以增加此議題的瞭解廣度。再進一步從職能的觀點來看，上述這些運動產生的健康效益，可以將運動這項職能活動視為一個促進思覺失調症個案健康的有效手段(occupation as means) (Gray, 1998)。

可惜的是，多數思覺失調症個案運動的參與度低，並未達到建議的身體活動量(Jerome et al., 2009)。影響此族群的運動行為因素，包括精神科藥物副作用、精神症狀及生理合併症(Glover, Ferron, & Whitley, 2013; Johnstone, 2009; McDevitt, Snyder, Miller, & Wilbur, 2006; Vancampfort et al., 2012)。除上述因素外，系統性文獻回顧整理出造成思覺失調症個案從事身體活動意願低落之相關因子，包括缺乏對心血管疾病危險因素的知識、沒有健康效益之信念、低自我效能感、不健康的生活習慣和社交畏縮等，也與身體活動參與率低落有關(Vancampfort et al., 2012)。另外，焦慮情緒、是否有支持網絡、擔心受到歧視以及運動時的安全問題亦皆為阻礙參與運動之原因。但過程中有參與者提到若所參與的運動有一定的規範須遵從是有助於方案執行(Johnstone, 2009; McDevitt et al., 2006)。這些近期的研究凸顯出探討影響思覺失調症運動參與因子的重要性，目前結果發現其影響因子乃是相當多元，但是對於個案在實際參與運動方案後的主觀經驗瞭解相當有限。

從職能的觀點出發，這些主觀參與經驗，將有助於增進對思覺失調症個案參與運動這項職能活動過程的理解。目前在臨床上會安排固定的運動時段來做為精神復健醫療的使用者健康促進方案，而此類型的團體常會遇到個案參與動機低而有執行上的困難，若可以增加對於思覺失調症個案在參與此結構化運動團體的經驗瞭解，包括助力因素和遭遇阻礙，這些發現將有助於發展此族群的合適運動方案，也就是增進思覺失調症在身體活動這項職能活動的參與(occupation as ends) (Gray, 1998)。

有別於過去透過個別訪談探討運動阻礙因子，本研究是由實際有運動經驗者進行訪談更能反應個案之感受。本研究目的有二：(1)了解思覺失調症個案對運動的健康效益面向；(2)探討參與規律結構化運動的阻礙與促進因子。

# 方法

## 一、計畫內容概述

本研究乃為一項隨機控制試驗研究之子計畫。原隨機控制試驗的主要目的為探討中等強度有氧運動對思覺失調症個案的認知療效。收案來源以高雄市醫療院所精神科日間病房及社區復健中心為主，此計畫通過人體試驗委員會之審查，參加者須簽署受試者同意書。參與者納入條件：(1)20-60 歲；(2)精神科專科醫師依據 DSM-IV 診斷為思覺失調症；(3)魏氏智力測驗在 70 分以上；(4)精神症狀穩定者，超過三個月未調整其主要的抗精神病藥物劑量；(5)主治醫師認為其可以安全地從事運動訓練。受試者排除條件：(1)發病時間少於一年以內；(2)曾有頭部外傷與其它神經損傷、酒精與藥物濫用、意識不清或意識混亂、懷孕、心血管疾病或是因肢體動作限制而無法進行運動訓練者。

研究對象同意參與後，即被隨機分派到實驗組與控制組。兩組皆為為結構化的運動方案，實驗組進行有氧運動，控制組進行伸展操。實驗組有氧運動內容為跑步運動，於收案單位的跑步機上進行，活動強度需達中等運動強度（55-69%的最大心跳率；最大心跳率為 220-年紀），一次 30 分鐘、一週 5 次，共為期 12 週。控制組為伸展操運動主要以伸展與放鬆動作為主，活動強度不超過 55%的最大心跳率，一次 30 分鐘、一週 5 次，共為期 12 週。兩組的訓練活動皆由同一位職能治療師以一對一方式進行。運動期間，皆配戴胸帶式的心率錶(Polar RS300; Polar Electro Oy, Finland),，藉以監控運動強度是否達到標準。為鼓勵參與者持續進行運動計畫，每完成一個月的運動計畫會發放禮卷給兩組成員做為回饋。

## 二、研究設計

本研究總收案時間為一年，共進行 7 次焦點團體。在完成整體運動方案後一個月內，會依組別各進行一次焦點團體，討論成員在參與過程中的主觀經驗。依照參與運動訓練方式分組進行焦點團體是考量參與者間有共同的運動經驗，在討論過程中能有更多的共鳴，可引起較多的發言。每次焦點團體進行約 60 分鐘，由兩位職能治療師帶領（一名為主要帶領者，一名為團體紀錄及觀察者），並依照其參

與訓練組別不同分別進行討論，在取得參與者同意後進行錄音。訪談大綱主要涵蓋參與者參加結構化運動方案的主觀的健康成效與參與經驗，見附錄一。

## 三、資料分析

此資料分析採用內容分析法(content analysis)進行分析，並使用 ATLAS.ti version 7.0 軟體(Scientific Software Development, Berlin, Germany)協助編碼及搜尋焦點團體的逐字稿。本文研究目的是期待透過參與者實際的參與經驗了解其主觀感受，進一步歸納出思覺失調症個案參與結構化運動主要的健康效益及可能影響個案參與運動方案的因素。內容分析法是一種社會及行為科學研究上常用的資料處理方法，其分析特點為對資料的內容作深入的系統性分析，並加以歸納分析，藉以增加對研究現象的知識以及理解程度，進而發現重要的主題或是影響這些研究現象的模式(patterns) (Hsieh & Shannon, 2005)。

有別於著重在形成理論的紮根理論研究法(grounded theory method)，內容分析法強調概念的發展或是模式的建立(Hsieh & Shannon, 2005)。內容分析法並非只是單純的計算逐字稿或觀察紀錄中各項字詞出現的頻率，而是在於理解這些資料後進行推論，研究者必須充實知識、費盡心思，才能將資料顯示的意義及其背景結合起來；研究者的知識也會因推論得當而更為豐富。內容分析是發展模式並加以延伸的審慎過程，也是從描述性的內容結果，闡釋其意義，探究研究現象的內涵（潘淑滿，民 92）。所以透過編碼將蒐集的資料分解成一個個單位，仔細檢視並比較異同，熟讀參與者的回答並且持續思考該內容與研究主題間的關係以及所代表的意涵(Strauss & Corbin, 1998)。

在閱讀逐字稿時，研究者根據該內容中我們找出與研究題目相關且有意義的語句做開放性編碼，如：「完成運動後動作比較敏捷」、「透過運動生活變得規律」、「運動後心情變愉悅」、「從事運動後做事專注度比較好」等。分析時，開放編碼與主編碼為同時進行，我們再將各項開放編碼加以類聚形成主題（即主軸編碼），例如: 開放編碼中的「完成運動後感到不易疲累」、「運動後體力變好，做登階表現有進步」等分析碼歸類為主軸編碼「活力增加」。

關於信效度方面，本研究舉行焦點團體有兩名職能治療師參與，並於團體後針對受訪所得訊息加以討論、取得共識，藉由研究者同儕的相互確認(peer examination)，以增加資料的信度和內在效度。透過多次的焦點團體收集思覺失調症參與不同的結構化運動方案(有氧跑步 vs.伸展操)亦有助於提升資料的可信度。最後，本研究針對參與者的篩選設有納入及排除條件，並描述兩種結構化運動方案之內容，此措施可增加資料的外在效度(Krefting, 1991)。

# 結果

本研究總共有 33 位參與者（有氧運動組 14 位、伸展操組 19 位。平均年齡為 36.5 歲、標準差 7.28；女性 17 位、男性 16 位）。研究訪談結果將對照研究目的加以陳述。

## 一、了解思覺失調症個案對運動的主觀健康效益

我們請參與者在完成為期三個月的運動方案後，描述運動對自己不論在生理或心理方面是否有所變化或影響。初期參與者皆提到對身體影響、抱怨不適等，但依照訪談大綱強化主題或詢問運動前後有何差別後，能誘發受試者其他面向的發言，且透過團體動力影響能讓成員試著感受運動所帶來的改變。受試者提及的面向大多先以生理反應為主，也有提到心情較為愉悅、情緒平穩等正向感受，在參與運動訓練過程到結束讓其獲得自信心及成就感。即使此訓練計畫為個別進行，但因個人自信心的提升、正向的情緒也影響到社交互動，有部分參與者主動提到人際關係感覺有所改善。

透過資料彙整、詮釋後，歸納出參與者透過運動計畫所經驗到的健康效益為下列幾項主題：活力增加、體重減輕、睡眠狀況改善、動作靈活度提升、情緒穩定度增加、自信心增加、專注度提升。另外，除了健康效益層面之外，亦歸納出幾項健康行為或觀念上的改變，包括生活較有規律性、社交主動性增加、參與事物動機增加，與健康促進概念的建立。

## *(一) 健康效益層面*

**1. 活力增加**

經過三個月的結構化運動方案，兩組的參與者表示體力有明顯改善且可在生活情境中有所感受，白天的疲倦度及嗜睡之情形有所改善，例如：「以前來社區，我都會在沙發再睡一下，到九點點名才起床，然後現在就不會想睡覺了。(F4b) 」、「比較不會累！整個人比較沒有那麼容易疲倦了。(M4b) 」、「就以前我登階只能做一分多鐘就做不下去了，現在做兩分多鐘快三分鐘，體力有比較好耶。(F5b)」以及「活動量有增加，腳程比較快、腳力也比較好。(F14a)」。

**2. 體重減輕**

有參與者在受訪過程中表示自覺體重有所變化，兩組的參與者皆有人提到此層面效果，未因運動強度的差異而有所不同。如:「我覺得體重有減輕啦！雖然本人比較瘦，可是有一陣子有一點小腹，可是經過這三個月運動過後小腹又沒有了。(M13a)」、「我覺得有變瘦一兩公斤這樣子。(M14b)」。

**3. 睡眠品質改善**

兩組運動組別皆有人表示有做運動期間返家後睡眠狀況有所改善，比較好入眠、整體睡眠品質也變好；對此情形，有參與者說可能因為活動量變多的原因。如「做完伸展操齁！回去會比較好睡......有在活動......會比較累所以好睡。(M10b)」、「變好睡了。因為之前都要靠安眠藥，現在比較不用了。(M13a)」。

**4. 動作靈活度提升**

雖然有部分參與者在此運動方案初期肢體感到不適，但也有參與者提到透過此結構化運動後動作協調度及肢體靈活度有所提升，動作反應較為快速、流暢，如「那個運動完......那個手腳比較靈活，啊會想要繼續做運動。比較不會痠痛(F5b)。」；而有氧運動組特別表示「腳程比較快、腳力比較好......我覺得行動比較敏捷。(F9a)」。

**5. 情緒穩定度增加**

有氧運動組個案表示，「心情會變好，不知道是不是那個運動產生那個嗎啡，就會比較......思緒會比較活絡這樣。可以有情緒的發洩這樣...... (F7a)」；相似的，

伸展操組也認為運動會促進心情愉悅，「講話也比較不會大小聲，就是心情比較平穩也不容易發脾氣。(M3b)」。

**6. 自信心增加**

參與者表示對於完成三個月的結構化運動方案後，感到有成就感，面對運動也較有自信，不會有過多的擔心、害怕。透過兩組不同運動方式的組別之描述，皆可發現參與者的自我效能都有所增加的。例如「可以完成這樣的跑步機運動，對於運動比較不會害怕......嗯......覺得自己比較敢挑戰其他運動。(M3a)」、「就......覺得自己可以這樣子持續三個月運動，覺得還蠻有成就感的。(F12b)」。也有表示對他人的話語比較不會太過在意、胡思亂想，這可能受自信心提升所產生的正向影響。

**7. 專注力提升**

參與者透過三個月結構化運動方案後表示在專注度方面是有所進展的。例如:「比較能夠集中注意力。工作比較能夠......完成的比較順利。(F17a)」、「我做完了運動以後齁，我在底下看書看得比較仔細啊！比較專心一點。(M9b)」、「以前就是比較沒有那麼持續，就是很容易中斷這個樣子。現在做事情比較能夠持續......(M5b)」；不論參與有氧運動或伸展操組之運動方案，都有成員提到專注度是有進步的。

### *（二）健康行為或觀念層面*

**1. 生活較有規律性**

兩組參與者提及生活變得較有重心、有規律性。如：「就是早上規律的來，規律做運動，然後每天都做，然後一整個禮拜，總覺得比較不會像以前那麼......那麼會賴床了。(M11b)」、「所以靠這樣子的運動把自己平常的生活作息，比較有規律這個樣子。(M3b)」。

**2. 社交主動性增加**

伸展操的成員表示：「我很內向我都不會主動跟人家打招呼，然後就覺得有做運動的話就是心情比較好，然後看到人就會想要打招呼。(M10b)」；而有氧運動組的成員也提到：「情緒也會比較穩一點，比較開朗了，還會主動跟人家講話。(F16a)」。透過上述相關敘述了解，參與者是因為心情有所改善後而提升與他人互動之動機。

**3.　參與事物動機增加**

在完成整個運動方案後，參與者對於生活事物參與度及動機有所提升；例如，有氧運動組提到「以前我如果遇到課堂上有我不喜歡上的課，我就會選擇逃避不想上，就會請假回家......現在情緒平穩很多也不會逃避課程、很少請假了。(F15a)」、「比較願意去動或者是洗車都很規律，不會像以前那樣沒事就不去，或者是什麼感冒啊，就是很累啊或者是怎麼樣。(M16a)」。而不論參與運動方案的差異，伸展操組的成員也提出相同的感受，如，「就每次回到家都還要煮飯嘛！以前都會覺得那個體力好像不太好，回到家會想睡覺可是做完伸展操回去之後腦筋就會動......想說今天煮什麼東西。(F10b)」。

**4.　健康促進概念的建立**

有氧運動的參與者提到藉由參與結構化的運動方案，體驗到運動帶來的健康效益，伸展操的參與者表示完成運動方案的過程中也能進一步提升對運動正向的認識及建立健康促進的概念，進而從事其他健康行為，如:「嗯，運動的過程然後也把自己的菸癮戒掉這個樣子；就是好像覺得應該要健康一點......人生要健康一點。(M5b)」。

## 二、探討參與規律結構化運動的阻礙與促進因子

### *(一) 完成運動方案之助力*

部分個案在參與前對運動的觀感是正向的，期待自己能透過運動可以獲得健康效益，達到減重效果，但也有參與者表示主動參與意願不高是因為工作人員多次鼓勵下才參加運動計畫。大部分的猶豫來自於質疑自己的體力擔心無法勝任運動計畫的要求，例如：「我變胖那麼多，應該是跑不動了或是走不動了，怕體力負荷不了。(M4a)」。有少部分的人因為被禮卷吸引而想加入。

完成運動方案之助力可分為外在動機和內在動機的層面。外在動機有：工作人員陪伴、實質的鼓勵；而內在動機包含參與者的意志力與願意配合運動方案的規範。

**1. 專業人員陪同**

兩組參與者皆表示研究人員（由同一位職能治療師擔任）的陪伴是在個案參與整個運動過程中重要的助力。「我覺得朋友跟老師都有支持我們，所以覺得很有信心，然後維持繼續運動的動力......老師啊！都會在旁邊陪我們講話跟我們加油打氣。(F16a)」、「覺得支持的原因就是有老師在帶。老師每天固定會來，我就每天固定會上去。平常如果是沒有老師帶的話，我就不會自己運動。(M14b)」。

**2. 有實質的鼓勵**

本運動方案為鼓勵個案參與有提供禮卷作為獎勵，兩組個案也都表示實質的獎勵是為完成運動的促進因子之一。「我覺得禮券也有一個誘因，後來知道有禮券又可以運動瘦身然後又有禮券怎麼這麼好！(F1a)」、「對！啊後來支持我的力量......是禮卷。(M5b)」。

**3. 意志力**

有參與者表示會完成整個運動方案是靠自己的意志力，自行設立一個目標然後試著去達成它。如，「我會想要維持體態耶! 所以就靠著這個意志力作完…只是好像沒有瘦。(F17a)」以及單純「為了我的健康!(M13a)」。

**4. 團體規範遵從度**

此運動方案採結構化型式進行，針對運動執行內容、時間皆有設計規範。兩組成員都有表示因為加入此方案就必須要配合相關規範，這也是促成完成整個運動方案之因素之一。例如「因為計畫就是這樣子，要把它完成才是一件事情啊！就是一個計畫你完成它之後你就達成你的目的了。我不用像台北這樣花錢去跑步、去健身房、去報名什麼......那個費用就省下來了啊！(F2a)」、「已經開始做運動，如果停下來就......感覺沒有做還是要繼續下去，而且老師會看有沒有做。(F6b)」。

### *(二) 要完成運動方案遇到的阻力*

在焦點團體中詢問參與者在運動訓練的過程中是否有曾經想放棄的念頭，或是遇到哪些困難而影響到繼續規律參與的意願。分析發現有體力負荷較大、身體出現不適、運動內容單調、需要他人鼓勵等阻力。

**1. 體力負荷較大**

參與者表示在執行運動方案的過程中體力的負荷是一大挑戰，時常感到疲累。有氧運動組的個案提到「對！我還要早上上班、下午掃地、晚上又做運動這樣子很累(M7a)。」；伸展操組參與者也有遇到相同的困擾，如：「然後我跟老師說還有一個月我就覺得很......很委屈，超累的。就一直延啊！然後原本說今天早上就變到下午，啊不然就是下午又移到明天這樣子。(F12b)」。

**2. 初期身體出現痠痛不適**

雖然有部分參與者表示透過運動方案自覺動作靈活度進步，但也會經歷身體痠痛、不適等狀況，這些痠痛不適情形大部分出現在有氧運動組的初期階段（約一個月左右），而伸展操組的參與者未有明顯之感受。有氧運動組的參與者陳述為「本來是正常，因為太久了舊傷是沒有復發啊，但跑到一半復發啊！老師是叫我看要不要把時間上做調整，還是說把姿勢做調整(M8a)」、「腳不舒服的時候，運動已經快結束的時候。本來是右腳不能走， 我就用左腳的力量。(F2a)」。

**3. 運動內容單調**

不論有氧運動或伸展操組其各自運動方案內容皆一致，兩組也都表示會感到有些乏味而影響參與意願。「快要結尾的時候。我就一直掛病號，沒生病也要說有生病。已經厭倦了，每天都一直重複同樣的動作。(M2a)」、 「嗯......我覺得好像是重覆做同樣的動作，讓我覺得很......很......很討厭就是......，後來才比較習慣。(M15b)」。

**4. 主動性低**

有參與者覺得運動是有益處的，但主動性低落、缺乏長時間的持續度，必須依賴職能治療師的督促才能被動完成，兩組成員對此層面的感受並無差異；例如，「運動時間到時，工作人員會一直叫我，有時沒有很想去，但還是得去。(M17a)」。

## 討論

本研究以訪談者的實際運動經驗以及參與運動計畫後自覺前後變化敘述，來探討社區復健中心的思覺失調症個案對三個月的結構化運動的主觀健康成效感受，

及參與運動計畫時所經驗到的主要的阻力和助力因素。有別於其他關於思覺失調症個案參與運動的成效或訪談個案對運動的觀感等研究，本研究訪談實際參與結構化運動的個案，並討論運動計畫所帶來的健康成效。相較於過去的量性成效研究，這些主觀資料可提供對先前研究結果之解釋，也可找出文獻中較少提及的成效，以做為未來研究的建議。比較不同運動形式和強度的主觀成效感受是否有差異，亦可了解思覺失調症個案參與運動的整體經驗，如初期不適應和後期所獲得的成就感等，藉此可協助臨床人員提供相關的健康促進方案。

從職能治療的觀點來看，本研究結果可以呼應將運動這項職能活動視為一個促進思覺失調症個案健康的有效手段(occupation as means) (Gray, 1998)，包括在生理與心理層面的影響。透過這些多元的健康效益，可以增進職能治療師在應用這項職能活動的功能性(functionality)，以及精障者對運動參與的動機。參與者主要所感受的健康效益層面為體重減輕、睡眠品質改善、活力增加，是與過去的研究結果一致。Beebe 等人(2005)藉研究得知，跑步機行走方案對穩定的思覺失調症個案可以帶來體脂肪明顯減少、有氧適能增加、身體質量指數減少。相關研究提及規律的運動會增加腦部慢波週期，提升睡眠品質(Reid et al., 2010)。

除此之外，參與者還有感受到情緒穩定度增加、自信心增加、社交主動性及參與事物動機增加、專注度提升、養成規律的健康生活形態等，這些健康效益及健康行為的改變也與文獻相互呼應。在情緒穩定度的部分，Scheewe 等人(2012)提出的研究結果發現，接受運動訓練的思覺失調症個案其憂鬱情形有顯著改善。一項針對大學生進行身體自我概念的開放性問卷調查，研究結果發現，運動對自我概念的影響最主要為從事運動行為可提高身體自我效能，進一步能提升個人的自尊心(Fox & Corbin, 1989)。Pajonk 研究團隊(2010)將思覺失調症個案分為有氧運動訓練組及桌上足球(控制組)為期共 3 個月，利用核磁共振了解其海馬迴是否改變。結果顯示，思覺失調症個案透過有氧運動其海馬迴體積變大是具有可塑性的，而認知功能也會因此有所影響。對照上述研究結果，於本焦點團體中許多參與者也提及自覺其自信心與專注度皆有提升。

關於運動對增進心理健康方面，依據社會學習假說(social learning hypothesis)認為經常運動的人會因為與他人接觸的機會增加，且運動所提供的情境是歡樂、

有趣與放鬆的，所以藉由運動中的人際互動對改善情緒是有相當幫助的（黃耀宗、李力康，民 87）。雖本研究運動介入方式為個別性質，但參與者表示因有固定的職能治療師陪同，透過互動與鼓勵能感到輕鬆的氣氛；且許多參與者有情緒愉悅、自信心提升等感受，也對於人際關係是有正向之影響。

關於參與者因參加運動方案進而建立規律生活作息和健康促進概念及行為（如：戒菸），可以透過人類職能模式(Model of Human Occupation，MOHO)來解釋(Kielhofner, 2008)。MOHO 著重在個體如何從事每日的職能活動，以及藉由這些職能活動的從事來達到成就感和自我認同；且認為職能的選擇和參與是個開放性系統，不同的職能參與會相互影響。MOHO 並強調，個體的意志(volition)、表現的習慣(habituation)和行為能力及技巧(performance capacity)可以透過職能的選擇和參與來加以維持或是改變。在本研究中，個案藉由每日參與運動方案來行塑習慣次系統，並體認到規律運動所帶來的健康效益，進而影響個案對自我健康概念的意志次系統，以及提升從事健康行為的能力和技巧次系統。每日規律運動行為的職能參與讓參與者對他們的職能選擇有更多的意識(insight)，且了解自我改善生活品質的潛力及知道哪些變數會對自己的生活帶來持續的改變。參與者透過進行持續性的結構化運動方案，使得其生活規律性提高，連帶地從事參與的動機也隨之提升。

在探討參與運動的助力及阻力因子的部分，在運動過程中主要的阻力因子為：感到疲累、身體不適、覺得運動內容乏味、缺乏主動性，需要他人督促，此結果可呼應過去研究(Johnstone, 2009; Vancampfort et al., 2012)。然而過去學者建議，透過增強個案參與運動之意願應可降低阻力因子的影響(McDevitt et al., 2006)。本研究參與者表示有工作人員陪同、實質的獎勵與此運動訓練計畫設計息息相關；有部分參與者因生理、心理的正向影響而感受到運動的益處，進而克服在運動過程中會有缺乏主動性、需要他人督促等問題。過去研究發現，當思覺失調症個案認為若運動過程有一定的規範遵從，其運動參與度也會比較高(McDevitt et al., 2006)，而在本研究中參與者也提出因為已答應參與此運動計畫就應該要完成，且計畫內容也有一定的規則需配合。

若與影響一般族群運動行為的因素進行比較(Dishman, Sallis, & Orenstein, 1985)，參與動機高低、實質的鼓勵、運動時的不適感和社交支持皆是會影響思覺失調症患者與健康成人族群的運動參與。而本研究發現的自覺體力無法負荷、運動內容單調的因素，則較少出現在一般族群。這可能與精障者本身的體力較差、承受挫折能力較差有關。再者，期待運動所帶來的健康效益、過去的運動經驗與本身的運動技能，則是屬於一般族群的顯著影響因子，並且較少出現在本研究參與者中。這之間的差異可能是健康族群對維持健康的動機較強，與精障族群過去的運動經驗和技能較差有關。

上述這些關於運動參與的阻礙及促進因子，將有助於職能治療人員在促進精障者在這項運動職能的參與程度。人-環境-職能模式(Person-Environment-Occupation Model，PEO Model)認為職能表現(occupational performance)會受到人、環境、職能等三個層面的影響，惟有三者達到最大的契合度，個體的職能表現才會達到最佳化(Law et al., 1996)。透過 PEO Model，可以理解精障者的運動參與表現受到這三個層面的影響，包括增進促進或是阻礙。在人的層面中，精障者本身的體力、運動初期產生的不適感，以及主動性低屬於阻礙因子；相反的，精障者個人的意志力則能促進參與。在環境層面，專業人員的陪同及鼓勵則會促進運動參與。職能層面，明確的團體規範有助於參與，但是運動內容過於單調則不利於精障者規律運動。

進一步來說，質性研究可以增進對「個人經驗」與「經驗情境」兩者的關係之瞭解，也就是瞭解到精障者運動參與經驗和運動情境之間的相關性。本研究發現社交情境對精障者的運動參與有重要的影響，包括專業人員一對一的指導、支持與禮卷的回饋。此外，物理與文化情境也是需要特別考量。跑步機運動搭配心率錶的使用，營造出一個類似健身房的物理環境氛圍。相較於外國文化，我國國民到健身房的經驗相對較少，透過類似健身房物理環境，可增加參與者的運動動機。而文化情境也包括我國社會對團體規範遵從度的重視(McDevitt et al., 2006)，會因專業人員（即陪伴運動的治療師）的出現與監督，和最初應允要完成 12 週的運動計畫的緣故，而持續參與整個運動方案。

本研究採用一對一的方式來進行運動方案，與目前社區精神復健場域常使用的團體運動方案有所不同。雖然兩者在社交情境上有所差異，但本研究所發現的重要影響精障者參與因子，仍值得團體運動方案參考，包括運動團體指導人員需要營造一個支持的環境、提供合適的增強物、強化團體規範，以及應用運動處方專業知識與相關設備，皆為可在團體型式中進行的有利因子。

一般而言，中等強度有氧運動是最能達到健康效益的，所以相對來說成效應該會比伸展操組來得好(Haskell et al., 2007)。但透過上述思覺失調症個案參與結構化運動方案的主觀感受之分析，兩組不同運動方案參與者在各層面的感受大致相同。僅在身體部分，有氧運動組的參與者在運動初期有明顯的身體痠痛、不適感，伸展操參與者則無此反應。這意味著可能活動型態差異對思覺失調症患者的健康成效是沒有影響的。進一步探討可能的原因發現相較於一般族群，精神疾病的正性症狀、抗精神病藥物的副作用（包括體重增加、運動功能下降等）及慢性生理疾病都可能會減少精障者身體活動的參與程度；這些因素可能使得思覺失調症患者從事本研究有氧運動時，無法負荷中等運動強度且沒有運動習慣造成生理上的不適等等，造成對此運動方式接收度較低（陳明德等，民 104；Ussher, Stanbury, Cheeseman, & Faulkner, 2007)。先前研究學者表示輕到中度運動強度的運動與激烈運動相較，確實較易讓人養成習慣而持續進行(Thompson, 2003)，且精障者最傾向的活動型態為中低強度的走路或是健走活動(Ussher et al., 2007)。本研究的伸展操運動內容屬於中低強度，相較之下參與者對此運動強度可以負荷，持續做此運動方案具挑戰性且能勝任。綜合上述原因，可能因此兩者運動型態反應的不同以致於其成效沒有明顯差別。而 Vancampfort 等學者(2011)針對思覺失調症個案透過瑜珈、有氧運動評估對其焦慮度、心理壓力以及生活安適感之變化。研究結果透過瑜珈以及有氧運動後，在焦慮度及心理壓力上呈現顯著的降低；而結果也顯示在瑜珈及有氧運動對於心理壓力及焦慮程度之間其效應值兩者間是沒有顯著差異的。而在本研究資料分析後也發現不管是伸展操或有氧運動組在身體及心理的成效上，個案的主觀感受除了參與有氧運動組成員初期身體產生明顯不適外，大致沒有明顯的差別。

本研究限制如下：利用焦點團體雖討論過程會引起共鳴，但有部分成員的陳述會受到其他成員的影響，建議後續研究可搭配個別訪談，以更深入了解參與者的感受做為補強。另外，本研究設計是於運動計畫結束後第四周即進行訪談，大部分焦點團體於此時限完成，而第五、六梯次因成員時間安排因素於第五周完成。但研究者發現部分成員對參與活動經驗的回憶有限或是會與當下生活情形有所混淆，故建議未來的研究可在運動團體結束後第二周即可進行焦點團體。另外，在考量運動方案帶來的健康效益，應該注意到本研究有固定的治療師在運動期間會與參與者進行一對一互動，這樣的支持性的人際互動與運動的實際成效有可能會相互干擾，因此宜謹慎解釋結果。未來，可以探討不同的運動類型（如：肌力訓練）、情境（如：團體運動）或是體育賽事(sport)所產生的健康效益和參與經驗。

藉此研究發現依照實際參與經驗中得知在個體與外在環境層面有特定的阻力及促進因子來影響思覺失調個案參與運動。而本研究所歸納出的阻力、促進因子以及個案對於參與運動後的主觀感受、對運動的概念等，能提供職能治療師在擬定健康促進方案及提供相關服務時的參考，也可作為執行成效的評估依據，進一步發展思覺失調症個案的健康促進計畫。期待精神疾病個案除了精神相關症狀穩定外，能改善其身心健康、強化整體健康維護，擁有更良好的生活品質。

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## 參考文獻

黃耀宗、季力康（民 97）。運動對心理健康的反應機轉。**中華體育季刊，12**，17-23。

潘淑滿（民 92）。**質性研究：理論與應用**。臺北市：心理出版社，334-335。

陳明德、易榮宣、郭昶志、郭明慧、歐千芸、張雁晴（民 104）。精神障礙者身體活動參

與影響因子與促進方案－文獻回顧。**職能治療學會雜誌，33**，7-24。

Acil, A. A., Dogan, S., & Dogan, O. (2008). The effects of physical exercises to mental state and quality of life in patients with schizophrenia. *Journal of Psychiatric and Mental Health Nursing, 15*(10), 808-815.

Allison, D. B., Newcomer, J. W., Dunn, A. L., Blumenthal, J. A., Fabricatore, A. N., Daumit, G. L., . . . Alpert, J. E. (2009). Obesity among those with mental disorders: a National Institute of Mental Health meeting report. *American Journal of Preventive Medicine, 36*(4), 341-350. doi:10.1016/j.amepre.2008.11.020

American Occupational Therapy Association. (2014). Occupational Therapy Practice Framework: Domain and Process (3rd Edition). *American Journal of Occupational Therapy, 68*(Supplement_1), S1-S48. doi:10.5014/ajot.2014.682006

Beebe, L. H., Tian, L., Morris, N., Goodwin, A., Allen, S. S., & Kuldau, J. (2005). Effects of exercise on mental and physical health parameters of persons with schizophrenia. *Issues Mental Health Nursing, 26*(6), 661-676.

Dishman, R. K., Sallis, J. F., & Orenstein, D. R. (1985). The determinants of physical activity and exercise. *Public Health Reports, 100*(2), 158-171.

Fox, K. R., & Corbin, C. B. (1989). The physical self-perception profile: Development and preliminary validation. *Journal of Sport and Exercise Psychology, 11*(4), 408-430.

Glover, C. M., Ferron, J. C., & Whitley, R. (2013). Barriers to exercise among people with severe mental illnesses. *Psychiatric Rehabilitation Journal, 36*(1), 45-47. doi:10.1037/h0094747

Gray, J. M. (1998). Putting Occupation Into Practice: Occupation as Ends, Occupation as Means. *American Journal of Occupational Therapy, 52(5)*, 354-364. doi:10.5014/ajot.52.5.354

Haskell, W. L., Lee, I. M., Pate, R. R., Powell, K. E., Blair, S. N., Franklin, B. A., . . . Bauman, A. (2007). Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Medicine & Science in Sports & Exercise, 39*(8), 1423-1434.

Holley, J., Crone, D., Tyson, P., & Lovell, G. . (2011). The effects of physical activity on psychological well−being for those with schizophrenia: A systematic review.

*British Journal of Clinical Psychology, 50*(1), 84-105.

Hsieh, H.-F., & Shannon, S. E. (2005). Three Approaches to Qualitative Content Analysis. *Qualitative Health Research, 15*(9), 1277-1288. doi:10.1177/1049732305276687

Jerome, G. J., Young, D. R., Dalcin, A., Charleston, J., Anthony, C., Hayes, J., & Daumit, G. L. (2009). Physical activity levels of persons with mental illness attending psychiatric rehabilitation programs. *Schizophrenia Research, 108*(1-3), 252-257. doi:10.1016/j.schres.2008.12.006

Johnstone, R. N., K.; Donaghy, M & Lawrie, S. . (2009). Barriers to uptake of physical activity in community-based patients with schizophrenia. *Journal of Mental Health, 18*, 523-532.

Kielhofner, G. (2008). *Model of Human Occupation Theory and Application (4th ed.)*. Baltimore: Lippincott Williams & Wilkins.

Krefting, L. (1991). Rigor in Qualitative Research: The Assessment of Trustworthiness. *American Journal of Occupational Therapy, 45*(3), 214-222. doi:10.5014/ajot.45.3.214

Law, M., Cooper, B., Strong, S., Stewart, D., Rigby, P., & Letts, L. (1996). The Person-Environment-Occupation Model: A Transactive Approach to Occupational Performance. *Canadian Journal of Occupational Therapy, 63*(1), 9-23. doi:10.1177/000841749606300103

McDevitt, J., Snyder, M., Miller, A., & Wilbur, J. (2006). Perceptions of barriers and benefits to physical activity among outpatients in psychiatric rehabilitation. *Journal of Nursing Scholarship, 38*(1), 50-55. doi:10.1111/j.1547-5069.2006.00077.x

Reid, K. J., Baron, K. G., Lu, B., Naylor, E., Wolfe, L., & Zee, P. C. (2010). Aerobic exercise improves self-reported sleep and quality of life in older adults with insomnia. *Sleep Medicine, 11*(9), 934-940. doi:10.1016/j.sleep.2010.04.014

Scheewe, T. W., Backx, F. J. G., Takken, T., Jörg, F., Strater, A. C. P., Kroes, A. G., ... & Cahn, W. . (2012). Exercise therapy improves mental and physical health in schizophrenia: a randomised controlled trial. *Acta Psychiatrica Scandinavica, 127*(6), 464-473.

Strauss, A., & Corbin, J. (1998). *Basics of Qualitative Research : Grounded Theory Procedures and Techniques*.台北：巨流.

Thompson, P. D. (2003). Exercise and physical activity in the prevention and treatment of atherosclerotic cardiovascular disease. *Arterioscler Thrombosis ,and Vascular Biology*, 23(8), 1319-1321. doi: 10.1161/01.ATV.0000087143.33998.F2

U.S. Department of Health and Human Services. (2008). Physical Activity Guidelines for Americans. Retrieved December 15, 2010, from http://www.health.gov/paguidelines/guidelines/default.aspx

Ussher, M., Stanbury, L., Cheeseman, V., & Faulkner, G. (2007). Physical activity preferences and perceived barriers to activity among persons with severe mental illness in the United Kingdom. *Psychiatric Services*, 58(3), 405-408. doi: 10.1176/appi.ps.58.3.405

Vancampfort, D., De Hert, M., Knapen, J., Wampers, M., Demunter, H., Deckx, S., . . . Probst, M. (2011). State anxiety, psychological stress and positive well-being responses to yoga and aerobic exercise in people with schizophrenia: a pilot study. *Disability and Rehabilitation, 33*(8), 684-689. doi:10.3109/09638288.2010.509458

Vancampfort, D., Knapen, J., Probst, M., Scheewe, T., Remans, S., & De Hert, M. (2012). A systematic review of correlates of physical activity in patients with schizophrenia. *Acta Psychiatrica Scandinavica, 125*(5), 352-362. doi:10.1111/j.1600-0447.2011.01814.x

**附錄 1**

焦點團體訪談內容大綱

| 問題屬性 | 問題內容 |
| --- | --- |
| 健康效益問題 | 經過三個月的運動後，您覺得有哪些改變呢？例如：生理或心理的改變？ |
| 正向參與經驗問題 | 什麼原因支持你可以完成三個月的運動計畫？ |
| 較敏感／負向經驗問題 | 過程中有想過要放棄嗎？什麼時候最想放棄呢？什麼原因讓你不想再參加？ |

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Original article

# The Health Benefits of Exercise Program and Factors Related to Participation in People with Schizophrenia

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Chang-Chih Kuo[a], Chwen-Yng Su[a], Ming-De Chen[a,d,*]

## Abstract

**Background and objectives:** Exercise training may improve health of people with schizophrenia. Most literature focused on the improvement in physical fitness and psychiatric symptoms, but less on other aspects of health outcomes. There is limited understanding about their subjective perspectives and experiences on exercise program. The objectives of the qualitative study were to (1) explore the health benefits of exercise intervention in people with schizophrenia; (2) investigate the facilitators of and barriers to regular participation in exercise program.

**Method:** Volunteers were randomly assigned into a flexibility exercise group or an aerobic exercise group. After the 3-month structured exercise program, participants were invited to a focus group. Qualitative data were analyzed using the content analysis method.

**Results:** Seven focus groups were conducted, including 33 respondents in total. Participants obviously experienced some benefits on health , including decreased body weight, and improved vitality, quality of sleep, agility, mood stability, self-confidence, attention, regular lifestyle, and motivation to social interaction and participate in daily activities, as well as development of health promotion concepts. Facilitators of exercise participation were company of the professional, rewards, willpower, and obligation to complete the exercise program. Barriers to participation contained physical fatigue, body discomfort at the beginning, monotonous exercise design, and low motivation.

**Conclusion:** Both exercise groups perceived improvement in physical and mental health. The identified facilitators and barriers could be used to develop exercise program for schizophrenia. Future research should examine subjective health benefits by quantitative measurements.

***Keywords:*** *Exercise Participation, Health Promotion, Physical Activity, Psychiatric*

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CME/Original article

# Potential Benefits of Supportive Intervention in Terms of Improving Daily Living Function for Patients with Alzheimer's Disease and Quality of Life of Caregivers



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## Abstract

Many older adults with dementia require constant assistance from caregivers when completing activities of daily living (ADL). This study aimed to determine the effects of ADL training consisting of the use of supporting prompts on ADL performance of patients with dementia, as well as the quality of life (QoL) of caregivers.

A randomized controlled trial was designed for patients with Alzheimer's disease (AD) and their family caregivers. The intervention was conducted in sessions once a month over a 4-month training program, or during a usual care group. One task was chosen, from grooming, dressing, shopping and medicine use, as the focus of an ADL training session, which then provided supporting skills in terms of verbal, visual, gesture, or physical prompts. The Disability Assessment of Dementia (DAD), Caregiver Burden Inventory (CBI) and 36-Item Short Form Health Survey (SF-36) were used to assess changes in ADL function, caregiver burden and QoL, respectively.

Thirty-three (68.7%) community-dwelling older adults with AD completed the whole study, including the final assessments. The treatment group ($n$=16) exhibited a significant delay in decline according to the DAD-basic ADL score ($p$=0.04), and optimal improvement in the SF-36 Physical Component Summary (PCS) score was observed for caregivers in the treatment group ($p$=0.009) in comparison with the control group ($n$=17). There was no significant change in the scores of the DAD-instrumental ADL ($p$=0.29), SF-36 MCS ($p$=0.95) or CBI ($p$=0.60) after the intervention.

We demonstrated that an intervention in which caregivers were taught to modify activity demands using prompts had immediate effects in terms of alleviating basic ADL disabilities in patients and perception of better physical health of caregivers. Thus, our study provided suggestions in terms of designing and implementing supportive intervention services for community-dwelling patients with dementia and their caregivers.

**Keywords:** *Activities of Daily Living, Alzheimer's Disease, Caregiver*

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# 1. Introduction

Dementia is one of the most common diseases among the elderly and has become an important issue in gerontology. In Taiwan, there are now more than 100 thousand people with dementia, and this figure will increase to at least 200 thousand by 2026 (Taiwan Alzheimer's Disease Association, 2012). Many dementia patients with mild to moderate functional disability live at home and receive care from their families (Akerborg et al., 2016; Rist, Capistrant, Wu, Marden, & Glymour, 2014). Patients' cognitive problems make it difficult to complete activities of daily living (ADL), and they therefore rely heavily on their cargivers. Evidence has shown that family caregivers experience high levels of burden and negative changes in their quality of life (QoL) due to the dementia patient's disability, psychological disorders, and behavioral problems (Bedford, Melzer, & Guralnik, 2001; Brodaty, Draper, & Low, 2003; Chiu, Hsieh, & Tsai, 2007), which prevent patients from being independent in ADL. Limitation in performing ADL is the main symptom of degenerative dementia. Individuals with dementia may not be able to perform a particular ADL task due to processing difficulties. Memory is critical for tasks that require the recall of numerous details (e.g., grocery shopping for a recipe). Patients with Alzheimer's disease (AD) show abnormal information processing following attentional processes with target stimuli during ADL owing to progressive decline of their memory. Investigators have demonstrated a link between memory deficits and everyday functional difficulties in patients with AD (Giovannetti, Schmidt, Gallo, Sestito, & Libon, 2006). Consequently, patients with dementia compensate for changes in ADL performance by decreasing the frequency of performing tasks, or by having caregivers provide assistance. Thus, there is a need to facilitate spontaneous initiation of ADL tasks within the home-based environment for dementia patients.

Most previous research has focused on maximizing life skills through various forms of specific types of prompt in populations with intellectual disability (van Vonderen, 2004; van Vonderen, Duker, & Didden, 2010). AD patients might perform best when task instructions are simplified or are supported by an explicit external prompt. A prompt can be a verbal command, a visual prompt, or a tactile/physical prompt such as gently guiding the body through the movement (Ledford, Lane, Elam, & Wolery, 2012; Mihailidis, Boger, Craig, & Hoey, 2008). It has been determined that use of prompts can allow participants to make significant gains in processing abilities and improve processing skills during ADL and other occupational activities (Padilla, 2011).

Compliance with clinical intervention is frequently compromised owing to financial strain or logistical difficulties, or for social and psychological reasons (Spijker et al., 2013). Caregiver-delivered intervention has emerged as an attractive alternative for increasing the quality of life of caregivers and potential treatment adherence of patients. However, regarding non-pharmacological interventions delivered through family caregivers, effective treatments for reversing ADL disability to delay decline as the disease progresses are still lacking.

The purpose of our study was to examine patient outcome in terms of ADL capacity following ADL skills training based on supporting prompts from caregivers in a hospital setting. In addition, another aim was to examine the benefits to caregivers in relation to burden and quality of life after participating in the intervention.

# 2. Methods

The study was designed as a single-blinded, randomized, controlled intervention trial. To evaluate the effectiveness of ADL skills training using a supporting prompt program, we carried out a randomized control trial (RCT). In the RCT, there were two parallel groups: the treatment group, in which caregivers took part in the ADL skills training intervention; and a control group, in which caregivers received the usual consultation intervention.

## *2.1 Participants*

This study was conducted in patients diagnosed with AD from a university-affiliated outpatient memory disorders clinic. Patients were included if they were mild or moderate AD based on both criteria of National Institute of Neurological and Communicative Disorders and Stroke–Alzheimer's Disease and Related Disorders Association criteria for probable Alzheimer's disease and Diagnostic and Statistical Manual of Mental Disorder, Fourth Edition (DSM-IV) and were aged at least 65 years. Patients were excluded from the study if they had mental illness and/or cognitive impairment, or if they had been the primary caregiver for less than 1 month.

This study enrolled family caregivers who met the following inclusion criteria: (1) aged at least 18 years and could speak and read Chinese; and (2) had provided care for at least 1 continuous month during the previous 3 months. Caregivers were excluded from the study if their patient had a mental illness and/or cognitive impairment, or if they had been the primary caregiver for less than 1 month. Written informed consent was obtained from patients and caregivers prior to baseline interviews using forms approved by the Institutional Review Board.

## 2.2 Procedures

Following baseline interviews, family caregivers were randomized assigned by blocked randomization to the treatment or control group. Block randomization with variable sizes was used as the randomization method. The allocation schedule was created using a computerized random number generator by an independent researcher and was unknown to the investigators of this study. Assessor (CY) blind to treatment assignment conducted assessments at baseline and after 4 months.

## 2.3 Intervention program

### *2.3.1 Treatment group*

Four tasks, consisting of grooming, dressing, shopping and medicine use, were chosen as the focus of the specific ADL training program, because these tasks, which require planning and initiation, are relatively safe activities for older adults with dementia. Each task was accompanied by four levels of assistance, including verbal or visual prompting, demonstration, or physical assistance, that provided support for the patient (Seelye, Schmitter-Edgecombe, Das, & Cook, 2012). Training focused on increasing supporting skills through face-to-face training for caregivers. The teaching materials included a PowerPoint presentation and a booklet received at the initial training session. The training content included knowledge regarding dementia and our hierarchical prompts education. Levels of prompt may range from neutral verbal statements (e.g., “It is the beginning of the day”) to directive statements (e.g., “Please get dressed now” or “Put this sock on your left foot”), and, when needed, may be accompanied by visual gestures (e.g., pointing at an item) or demonstrating movement or physical prompts (e.g., touching the person’s left foot while stating).

In addition, facilitator techniques were taught through role-playing with the use of ‘simulated patients’ to teach caregivers ways in which to effectively use the newly-learned skills in their homes. The simulated patients were designed to be able to provide a range of cues and responses during communication in the role-play, and provided a safe opportunity during which to practice communication behaviors without distressing patients. In this study, the simulated patient role was played by the second author, who has a license in occupational therapy and experience and knowledge of the issue of communication difficulties in patients with dementia. This program was conducted under the supervision of the first researcher, who has several years of experience as a university assistant professor in psychiatry. The experimental group attended up to four 30-minute face-to-face ADL training sessions, which were held once per month.

*2.3.2 Control group*

The control group received only a booklet containing a brief explanation of the program content. They then attended up to four face-to-face interviews consisting of normal consultations once a month for 4 months.

## *2.4 Outcome measures*

The Chinese version of the Disability Assessment for Dementia (DAD) (Mok et al., 2005) is an informant-rated questionnaire consisting of 40 items regarding the subject's involvement in ADL. Seventeen items address basic ADL (BADL; including hygiene, dressing, continence and eating), and 23 items relate to instrumental ADL (IADL; including meal preparation, telephoning, going on an outing, finance and correspondence, medications, and leisure and housework). Items can be categorized into initiation, planning and organization, and effective performance subscales, though the total score is used most frequently. Non-applicable items (e.g., those that a patient did not participate in even before the onset of their illness) are excluded from scoring, with the final scores being converted to a percentage. Scores thus have a potential range from 0 to 100%, with higher percentage scores representing greater competence in ADL. The DAD has a satisfactory internal consistency (Cronbach’s alpha of 0.91 for the total score) and excellent test–retest and inter-rater reliabilities of 0.99 and 0.98, respectively (Mok et al., 2005).

The Chinese version of the Caregiver Burden Inventory (CBI) (Chou, Jiann-Chyun, & Chu, 2002) is a 24-item, caregiver-reported measure of burden. Responses to each item are rated on a self-reported 5-point Likert scale, ranging from 0 (not at all disruptive) to 4 (very disruptive). The CBI has 5 domains: time-dependence burden, developmental burden, physical burden, social burden and emotional burden. The global score is obtained by summing the scores of each subscale; higher scores correspond to greater levels of perceived burden. The C-CBI has been demonstrated to have a satisfactory internal consistency (Cronbach's alpha of 0.9) and an appropriate content validity (Chou, Jiann-Chyun, & Chu, 2002).

The Chinese Short Form (SF)-36 Health Survey (Fuh, Wang, Lu, Juang, & Lee, 2000) is a patient-reported survey of patient health. The SF-36 is a measure of health status and an abbreviated variant of the full version. The SF-36 consists of eight scaled scores, which are the weighted sums of the question scores in each section. Each scale is directly transformed into a 0–100 scale on the assumption that each question carries equal weight. On the SF-36, health status is broken down into two general factors by calculating the means of mental health-related quality of life (HRQOL) (e.g., vitality, social functioning, mental health, emotional role-limitations) and physical HRQOL (e.g., physical functioning, physical role-limitations, pain, general health). These eight scales can be aggregated into two summary measures: the Physical and Mental Component Summary (PCS and MCS, respectively) scores. The lower the score, the greater disability; i.e., a score of zero is equivalent to maximum disability and a score of 100 is equivalent to no disability. Studies have shown that the SF-36 has good reliability and validity for health status measurement in Taiwanese populations. The Cronbach alpha coefficient of the SF-36 remained above 0.70 (Fuh, Wang, Lu, Juang, & Lee, 2000).

### *2.5 Data analysis*

Statistical analyses were performed using SPSS version 20. All data collected were initially analyzed by descriptive statistics, with continuous variables expressed as means (*SD*) and categorical variables as percentages. Student's t-tests or chi-square analyses were conducted to compare the demographic data and baseline outcome measures (DAD-BADL, DAD-IADL, CBI, SF-36 PCS and SF-36 MCS) of caregivers and care recipients between the intervention and the comparison groups. Non-parametric statistical analyses were conducted on the scores of the DAD-BADL, DAD-IADL, CBI, SF-36 PCS and SF-36 MCS to assess within-group and between-group differences. All statistical tests were two-tailed. The alpha criterion for significance was 0.05 or less.

## 3. Results

### *3.1 Sample characteristics*

Descriptive statistics of the primary caregivers are shown in Table 1. Of 68 caregivers screened, 43 (63%) were eligible for enrollment, of whom 33 dyads were willing to participate. The main reasons for non-participation included caregivers' time constraints and failure to return. Comparison of the demographic and baseline characteristics between the intervention group ($n$=16) and the comparison group ($n$=17) indicated that the two groups were comparable in terms of all demographic variables, as well as all baseline measures; none of the *p*-values was significant. The differences in demographic variables between the two groups (Table 1) were not significant at baseline. In the patient sample, the participants were of a mean of 78.8 years of age, with a mean duration from dementia diagnosis of 2.2 years at baseline. In the caregiver sample, 64% were women, with an average age of 57.0 years; over half of them were children (61%) of the patients, and had a level of education greater than high school (59%).

### 3.2 Effects of intervention on study outcomes

The values at baseline and post-intervention, and changes in the mean or median scores of the DAD-BADL, DAD-IADL, CBI, SF-36 PCS and SF-36 MCS of the intervention and control groups are displayed in Table 2. Non-parametric statistics (Wilcoxon-Mann-Whitney U-test) were conducted to examine whether the effects of intervention differed within and between groups. Figure 1 illustrates using box plots the differences in the scores on the DAD, CBI and SF-36 within and between groups.

In terms of patient outcomes, the total score of the DAD-BADL of the intervention group increased from 83.0 (*SD* = 23.3; median = 84.0) at entry to 85.3 (*SD* = 27.3; median = 84.2) ($p$ = 0.78) at the end of intervention, while that for the comparison group reduced from 79.7 (*SD* = 39.9; median = 77.3) to 62.1 ± 37.4 (*SD* = 37.4; median = 64.0) ($p$ = 0.008). The total score of the DAD-IADL of the intervention group increased from 42.6 (*SD* = 30.7; median = 42.2) at entry to 45.5 (*SD* = 37.4; median = 45.7) ($p$ = 0.92) at the end of intervention, while that for the comparison group reduced from 32.2 (*SD* = 30.9; median = 32.1) to 21.5 (*SD* = 20.7; median = 21.3) ($p$ = 0.11).

Comparisons of the changes in the DAD subscale scores between the two groups revealed a statistically-significant delayed disability only in terms of BADL capacity (*p* = 0.04).

Regarding caregiver outcomes, the score of the SF-36 PCS of the intervention group increased from 50.0 (*SD* = 3.9; median = 50.0) at entry to 51.7 (*SD* = 4.8; median = 50.9) (*p* = 0.03) at the end of intervention, while that for the comparison group reduced from 50.7 (*SD* = 5.4; median = 51.1) to 49.6 (*SD* = 7.0; median = 49.0) (*p* = 0.13). The score of the SF-36 MCS of the intervention group increased from 49.8 (*SD* = 7.3; median = 50.0) at entry to 50.8 (*SD* = 6.5; median = 50.2) (*p* = 0.22) at the end of intervention, while that for the comparison group reduced from 48.69 (*SD* = 9.5; median =49.6) to 48.3 (*SD* = 7.4; median = 49.5) (*p* = 0.73). Comparison of the change in the SF-36 PCS score between the two groups revealed statistical significance (*p* = 0.009); however, the change in the score of the SF-36 MCS was not significant. The total score of the CBI of the intervention group reduced from 36.3 (*SD* = 19.5; median = 39.0) at entry to 35.6 (*SD* = 17.8; median = 35.0) (*p* = 0.71) at the end of intervention, while that for the comparison group increased from 36.1 (*SD* = 18.8; median = 34.0) to 37.3 (*SD* =19.8; median = 36.0) (*p* = 0.78). The change in the score of the CBI (*p* = 0.60) did not differ in terms of statistical significance between the two groups.

**Table 1**

Demographic and baseline characteristics of the intervention and control groups

| | Intervention group ($n$ = 16) | Control group ($n$ = 17) | Statistics | $p$ value |
|---|---|---|---|---|
| **Demographic characteristics** | | | | |
| **Patients** | | | | |
| Disease duration (years) | 2.0 (0.8) | 2.3 (1.4) | $t$ = 0.46 | 0.84 |
| Care receipt age | 79.5 (8.5) | 78.1 (8.1) | $t$ = -0.523 | 0.61 |
| **Caregivers** | | | | |
| Age (years) (*SD*) | 54.8 (10.0) | 59.2 (10.7) | $t$ = 0.37 | 0.23 |
| Female (%) | 11 (69%) | 10 (59%) | $X^2$ = 0.26 | 0.51 |
| **Years of education** | | | | |
| ≥6 | 0 | 5 | | |
| 7–9 | 1 (6%) | 1 (6%) | | |
| 10–12 | 4 (25%) | 3 (18%) | $X^2$ = 5.6 | 0.13 |
| ＜12 | 11 (69%) | 8 (47%) | | |
| **Caregiver relationship** | | | | |
| Spouse | 3 (19%) | 5 (29%) | | |
| Child | 10 (62%) | 10 (59%) | $X^2$ = 0.67 | 0.72 |
| Other | 3 (19%) | 2 (12%) | | |
| **Baseline characteristics** | | | | |
| DAD-BADL | 83.0 (23.3) | 79.7 (39.9) | $U$ = 102 | 0.29 |
| DAD-IADL | 42.6 (30.7) | 32.2 (30.9) | $U$ = 104 | 0.28 |
| SF-36 PCS | 51.7 (3.9) | 49.6 (5.4) | $U$ = 89 | 0.23 |
| SF-36 MCS | 50.8 (7.3) | 48.9 (9.5) | $U$ = 113 | 0.80 |
| CBI | 36.3 (19.5) | 36.1 (18.8) | $U$ = 116.5 | 0.85 |

DAD: Disability Assessment for Dementia; DAD-BADL: DAD sub-score for Basic Activities of Daily Living; DAD-IADL: DAD sub-score for Instrumental Activities of Daily Living; SF-36 PCS: Short Form-36 Physical Component Summary; SF-36 MCS: Short Form-36 Mental Component Summary; CBI: Caregiver Burden Inventory.

**Table 2**
Baseline and post-test scores, and comparisons of changes in DAD, CBI and SF-36 scores in both groups

| | Intervention group | | | Control group | | | |
|---|---|---|---|---|---|---|---|
| | Baseline | Post-test | Within-group *p* value | Baseline | Post-test | Within-group *p* value | Between-group *p* value |
| **DAD-BADL** | | | | | | | |
| Mean | 83.0 | 85.3 | 0.78 | 79.7 | 62.1 | 0.008* | 0.04* |
| SD | 23.3 | 27.3 | | 39.9 | 37.4 | | |
| Median | 84.0 | 84.2 | | 77.3 | 64.0 | | |
| Min–Max | 31-100 | 37-100 | | 28-100 | 26-100 | | |
| **DAD-IADL** | | | | | | | |
| Mean | 42.6 | 45.5 | 0.92 | 32.2 | 21.5 | 0.114 | 0.29 |
| SD | 30.7 | 37.4 | | 30.9 | 20.7 | | |
| Median | 42.2 | 45.7 | | 32.1 | 21.3 | | |
| Min–Max | 0-100 | 0-100 | | 0-100 | 0-94 | | |
| **SF-36 PCS** | | | | | | | |
| Mean | 50.0 | 51.7 | 0.03* | 50.7 | 49.6 | 0.13 | 0.009* |
| SD | 4.8 | 3.9 | | 7.0 | 5.4 | | |
| Median | 50.0 | 50.9 | | 51.1 | 49.0 | | |
| Min–Max | 40-59 | 38-61 | | 44-58 | 41-56 | | |
| **SF-36 MCS** | | | | | | | |
| Mean | 49.8 | 50.8 | 0.22 | 48.3 | 48.9 | 0.73 | 0.95 |
| SD | 6.5 | 7.3 | | 7.4 | 9.5 | | |
| Median | 50.0 | 50.2 | | 49.6 | 49.5 | | |
| Min–Max | 40-63 | 38-65 | | 36-57 | 31-65 | | |
| **CBI** | | | | | | | |
| Mean | 36.3 | 35.6 | 0.71 | 36.1 | 37.3 | 0.78 | 0.60 |
| SD | 19.5 | 17.8 | | 18.8 | 19.8 | | |
| Median | 39 | 35 | | 34 | 36 | | |
| Min–Max | 5-62 | 7-71 | | 9-78 | 7-70 | | |

SD: standard deviation; Min: minimum value; Max: maximum value; DAD: Disability Assessment for Dementia; DAD-BADL: DAD sub-score for Basic Activities of Daily Living; DAD-IADL: DAD sub-score for Instrumental Activities of Daily Living; SF-36 PCS: Short Form-36 Physical Component Summary; SF-36 MCS: Short Form-36 Mental Component Summary; CBI: Caregiver Burden Inventory.
*Statistically significant at $p < 0.05$.

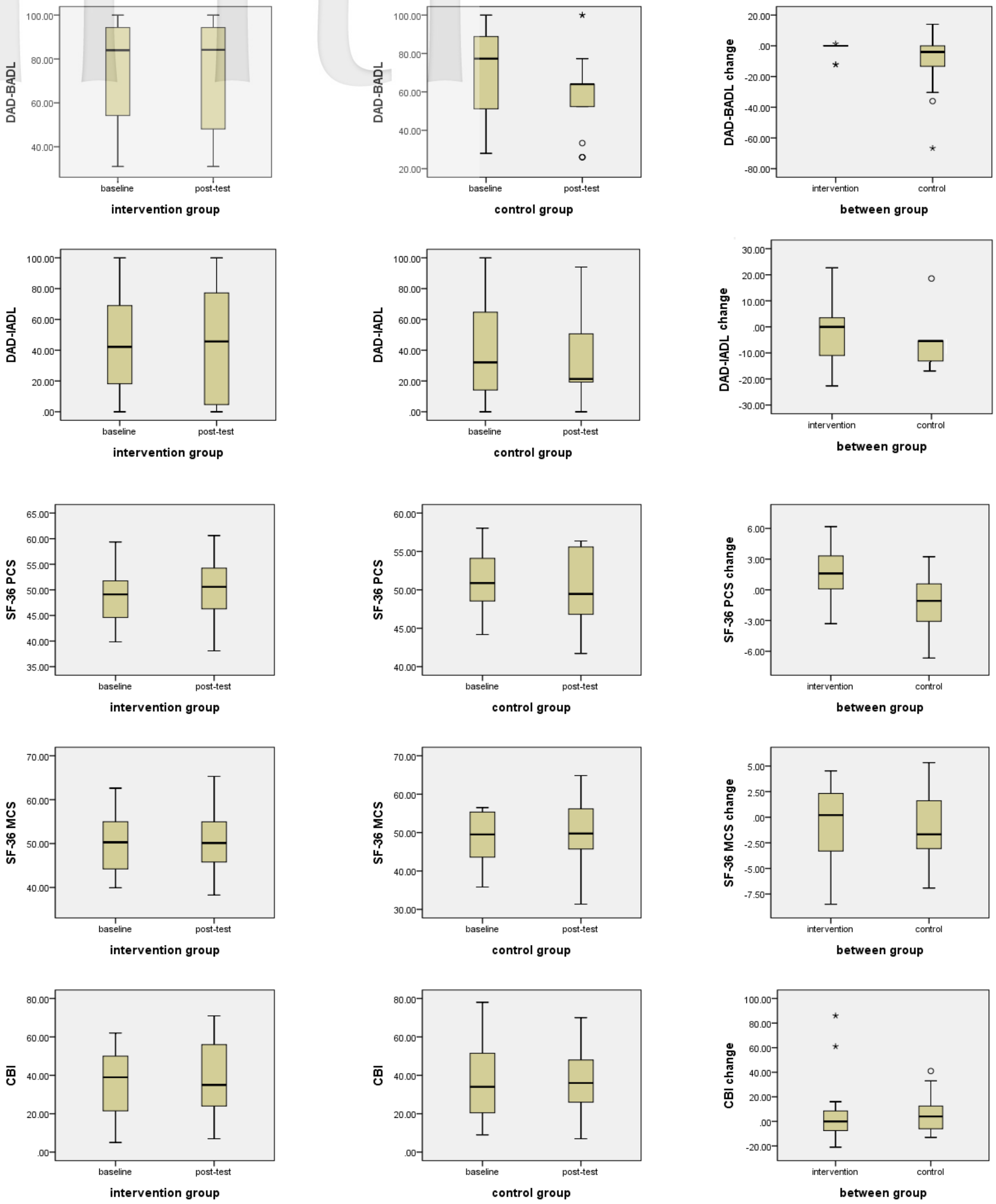


**Figure 1**

Box plots of the baseline and post-test scores, and comparisons of changes in the DAD, SF36 and CBI within (intervention /control) and between groups. Group medians and quartiles are shown for each outcome variable. Open circles represent outlying points, while (*) represents extreme points. DAD: Disability Assessment for Dementia; DAD-BADL: DAD sub-score for Basic Activities of Daily Living; DAD-IADL: DAD sub-score for Instrumental Activities of Daily Living; SF-36: Short Form-36, PCS: Physical Component Summary; MCS: Mental Component Summary; CBI: Caregiver Burden Inventory.

# 4. Discussion

The objective of this study was to investigate the effectiveness of ADL skills training for caregivers using hierarchical prompts based on four ADL tasks, with the aim of reducing disability in patients and improving quality of life and lessening the burden of family caregivers. We found that an intervention using modified activity demands through cues had immediate effects in terms of alleviating BADL disabilities in patients, as well as resulted in a perception of a higher physical QoL of caregivers. Thus, our intervention through caregiver-mediated, ADL task-based interventions employing the prompting technique provides the basis for potential service provision for community-dwelling patients with dementia and their caregivers.

In our participants, a decreased IADL performance preceded the decrease in BADL performance, which is consistent with the nature of dementia progression. Our results showed maintenance of DAD-BADL capacity within the intervention group, whereas the control group exhibited a significantly greater decline in the BADL score. This result indicated that our program was associated with a reduced rate of BADL decline, as compared with the more rapid BADL decline seen in the dementia patients in the control group. A previous report observed that the rate of change of the DAD-BADL score was 4.4 points in 6 months (Feldman et al., 2001). The slightly smaller BADL improvement of the intervention group in the current study (of about 2.3 points) likely eliminated the onset of accelerated BADL decline and maintained daily functioning in the patients with dementia during the 4-

month intervention period. These findings may reflect that the sooner the ADL skills program for dementia caregivers is initiated, the greater the preservation of BADL capacity. In contrast, there was no significant improvement or change in the IADL score within and between groups. This finding might suggest that our ADL skills training with supporting prompts can delay the most important aspects of BADL decline and provide benefits in terms of basic activities of daily living performance for caregivers supporting patients with dementia, but has no effect on IADL. A possible reason for this is that caregivers are more concerned with preserving a patient's ability to perform basic ADL than they are about preserving instrumental ADL for patients with dementia (Hauber et al., 2014). As such, caregivers are most likely to serve as facilitators in the BADL context, providing the most needed care and assistance cues, rather than in the IADL context. Using prompts with structured caregiving education appears to be a feasible training method owing to the strong link between executive function and processing skills in the ADL context in dementia patients. The results of this study may enable healthcare providers and developers of dementia treatments to maximize ADL functioning, which is an important factor in maintaining QoL. Further studies are needed in order to evaluate the potential long-term benefits of our intervention on daily life performance.

We also observed improvement in terms of the SF-36 score only in the physical domain within the intervention group, and not in the mental domain. Apparently, our intervention, which focused primarily on increasing ADL capacity, improved physical well-being. The physical impact of caregiving is closely associated with the physical tasks that caregivers are expected to perform. Such a perception of caregivers regarding physical health is a possible reason for the reduction in decline of disability in terms of BADL tasks according to the DAD score in our intervention group. This effect of minimizing BADL disability was likely due to the more positive physical well-being of family caregivers. Caregivers in the intervention group might have become more aware that ADL assistance is not only physical in nature, but also involves non-physical support when providing care for patients with dementia; this may result in maintenance of a sustained effect on the physical health of the caregiver. Thus, our findings suggested that ADL skills training is a successful problem-focused coping strategy that improves the physical well-being of caregivers who are caring for family members with dementia.

In this study, a slight decrease in the CBI score of the caregivers in the intervention group was observed, whereas this was greater in the control group, despite not reaching statistical significance. Assistance with many routine ADL tasks involves high emotional and physical demands on the caregiver (Kesselring et al., 2001). As caregiver burden has been shown to be more highly correlated with the SF-36 mental components than the physical dimensions (Martinez-Martin et al., 2007), this led to failure to perceive global benefits of the intervention. Although our intervention resulted in a slowing of ADL decline, which is important for patients, these differences may be lost on caregivers.

ADL tasks involve repetitive practice in real life. The use of ADL-oriented training is supported by procedural memory, which is retained into the later stages of dementia and allows researchers to target the cognitive strengths of patients with dementia (Ciro, Hershey, & Garrison, 2013; Preissner, 2010). In this study, the daily context of ADL-oriented training by progressively stronger assistive prompts appeared to result in maximizing the ADL capacity for everyday tasks, and marked improvement was observed in the basic ADL abilities of the patients and the physical well-being of the caregivers. These finding suggested that ADL-oriented programs are a feasible option in certain healthcare systems.

It is generally accepted that enabling people to continue to perform activities that they were previously able to carry out is good for self-esteem (Ide-Okochi, Tadaka, & Fujimura, 2013; Landa-Gonzalez & Molnar, 2012). Indeed, providing a means of support for activities that involve several steps is considered to be important in terms of the quality of life of people with dementia (Orpwood, Sixsmith, Torrington, Chadd, & Chalfont, 2007). Most caregivers are the spouse or a close relative of the patient, and therefore live in the same environment and are likely to have the same living pattern. As such, they are most likely to be able to serve as facilitators for the patients, providing the most needed care and daily living skills. The results of this study showed that our program effectively maintained or enhanced the ability of the caregiver to administer care. Our program may be helpful with regards to the long-term effect of preserving ADL functioning of dementia patients.

Some limitations of this study need to be addressed. First, the patients and their caregivers were enrolled from memory clinics, and thus were not entirely community-dwelling adults with dementia and caregivers.

Furthermore, only a small number of subjects were recruited, so the results cannot be generalized to all dementia patients and their caregivers. Future studies with large samples are needed in order to explore the relationships between treatment, ADL decline, and caregiver burden or QoL. The study did not involve long-term follow-up of the patients after intervention, which would enable us to ascertain whether the intervention effects persisted past the end of the treatment period.

In summary, the entire treatment group of dementia patients demonstrated gains in terms of maintenance of BADL capacity, and there was an improved sense of physical QoL of the caregivers. These data demonstrated that this intervention was beneficial for a community-dwelling population of dementia patients and caregivers. The findings also suggested that further research is warranted to evaluate a more long-term intervention involving supporting prompts, and assess the underlying mechanisms and the impact on caregiver QoL. Finally, the findings provided preliminary evidence of the importance of examining intervention effects for caregivers to enable them to cope successfully with long-term caring.

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# References

Akerborg, O., Lang, A., Wimo, A., Skoldunger, A., Fratiglioni, L., Gaudig, M., & Rosenlund, M. (2016). Cost of dementia and Its correlation with dependence. *Journal of Aging and Health*. doi: 10.1177/0898264315624899

Arrighi, H. M., Gelinas, I., McLaughlin, T. P., Buchanan, J., & Gauthier, S. (2013). Longitudinal changes in functional disability in Alzheimer's disease patients. *International Psychogeriatrics, 25*(6), 929-937. doi: 10.1017/S1041610212002360

Bedford, S, Melzer, D., & Guralnik, J. (2001). Problem behavior in the last year of life: prevalence, risks, and care receipt in older Americans. *Journal of the American Geriatrics Societyc, 49*(5), 590-595.

Brodaty, H., Draper, B.M, & Low, L.F. (2003). Behavioural and psychological symptoms of dementia: a seven-tiered model of service delivery. *Medical Journal of Australia, 178*(5), 231-234.

Chiu, L. J., Hsieh, C. J., & Tsai, S. L. (2007). Exploring the relationship between stressors, appraisal, coping and health among the family caregivers of elderly dementia patients. *The Journal of Psychiatric Mental Health Nursing, 2*, 31-44.

Chou, K. R., Jiann-Chyun, L., & Chu, H. (2002). The reliability and validity of the Chinese version of the caregiver burden inventory. *Nursing Research, 51*(5), 324-331.

Ciro, C. A., Hershey, L. A., & Garrison, D. (2013). Enhanced task-oriented training in a person with dementia with Lewy bodies. *American Journal of Occupational Therapy, 67*(5), 556-563. doi: 10.5014/ajot.2013.008227

De Vreese, L. P., Caffarra, P., Savare, R., Cerutti, R., Franceschi, M., & Grossi, E.

(2008). Functional disability in early Alzheimer's disease - a validation study of the Italian version of the disability assessment for dementia scale. *Dementia and Geriatric Cognitive Disorders, 25*(2), 186-194. doi: 10.1159/000113415

Feldman, H., Sauter, A., Donald, A., Gelinas, I., Gauthier, S., Torfs, K., . . . Mehnert, A. (2001). The disability assessment for dementia scale: a 12-month study of functional ability in mild to moderate severity Alzheimer disease. *Alzheimer Disease & Associated Disorders, 15*(2), 89-95.

Fuh, J. L., Wang, S. J., Lu, S. R., Juang, K. D., & Lee, S. J. (2000). Psychometric evaluation of a Chinese (Taiwanese) version of the SF-36 health survey amongst middle-aged women from a rural community. *Quality of Life Research, 9*(6), 675-683.

Giovannetti, T., Schmidt, K. S., Gallo, J. L., Sestito, N., & Libon, D. J. (2006). Everyday action in dementia: evidence for differential deficits in Alzheimer's disease versus subcortical vascular dementia. *Journal of the International Neuropsychological Society 12*(1), 45-53. doi: 10.1017/S1355617706060012

Hauber, A. B., Mohamed, A. F., Johnson, F. R., Cook, M., Arrighi, H. M., Zhang, J., & Grundman, M. (2014). Understanding the relative importance of preserving functional abilities in Alzheimer's disease in the United States and Germany. *Quality of Life Research, 23*(6), 1813-1821. doi: 10.1007/s11136-013-0620-5

Ide-Okochi, A., Tadaka, E., & Fujimura, K. (2013). The meaning of self-care in persons with cervical spinal cord injury in Japan: a qualitative study. *BMC Neurol, 13*, 115. doi: 10.1186/1471-2377-13-115

Jhoo, J. H., Chi, Y. K., Choi, H. J., Han, J. W., Kim, T. H., Lee, J. J., . . . Kim, K. W. (2014). A normative study of the disability assessment for dementia in community-dwelling elderly koreans. *Psychiatry Investigation, 11*(4), 446-453. doi: 10.4306/pi.2014.11.4.446

Kesselring, A., Krulik, T., Bichsel, M., Minder, C., Beck, J. C., & Stuck, A. E. (2001). Emotional and physical demands on caregivers in home care to the elderly in Switzerland and their relationship to nursing home admission. *European Journal of Public Health, 11*(3), 267-273.

Landa-Gonzalez, B., & Molnar, D. (2012). Occupational therapy intervention: effects on self-care, performance, satisfaction, self-esteem/self-efficacy, and role functioning of older Hispanic females with arthritis. *Occupational Therapy In Health Care, 26*(2-3), 109-119. doi: 10.3109/07380577.2011.644624

Ledford, J. R., Lane, J. D., Elam, K. L., & Wolery, M. (2012). Using response-prompting procedures during small-group direct instruction: outcomes and procedural variations. *American Journal on Intellectual and Developmental Disabilities, 117*(5), 413-434. doi: 10.1352/1944-7558-117.5.413

Martinez-Martin, P., Forjaz, M. J., Frades-Payo, B., Rusinol, A. B., Fernandez-Garcia, J. M., Benito-Leon, J., . . . Catalan, M. J. (2007). Caregiver burden in Parkinson's disease. *Movement Disorders, 22*(7), 924-931; quiz 1060. doi: 10.1002/mds.21355

Mihailidis, A., Boger, J. N., Craig, T., & Hoey, J. (2008). The COACH prompting system to assist older adults with dementia through handwashing: an efficacy study. *BMC Geriatrics, 8*, 28. doi: 10.1186/1471-2318-8-28

Mok, C. C., Siu, A. M., Chan, W. C., Yeung, K. M., Pan, P. C., & Li, S. W. (2005). Functional disabilities profile of chinese elderly people with Alzheimer's disease - a validation study on the chinese version of the disability assessment for dementia. *Dementia and Geriatric Cognitive Disorders, 20*(2-3), 112-119. doi:

10.1159/000086612

Orpwood, R., Sixsmith, A., Torrington, J., Chadd, J., Gibson, G., & Chalfont, G. . (2007). Designing technology to support quality of life of people with dementia. *Technology and Disability, 19*, 103-112.

Padilla, R. (2011). Effectiveness of interventions designed to modify the activity demands of the occupations of self-care and leisure for people with Alzheimer's disease and related dementias. *American Journal of Occupational Therapy, 65*(5), 523-531.

Preissner, K. (2010). Use of the Occupational Therapy Task-Oriented Approach to optimize the motor performance of a client with cognitive limitations. *American Journal of Occupational Therapy, 64*(5), 727-734.

Rist, P. M., Capistrant, B. D., Wu, Q., Marden, J. R., & Glymour, M. M. (2014). Dementia and dependence: do modifiable risk factors delay disability? *Neurology, 82*(17), 1543-1550. doi: 10.1212/WNL.0000000000000357

Rueda, A. D., Lau, K. M., Saito, N., Harvey, D., Risacher, S. L., Aisen, P. S., . . . Tomaszewski Farias, S. (2014). Self-rated and informant-rated everyday function in comparison to objective markers of Alzheimer's disease. *Alzheimer's & Dementia,* doi: 10.1016/j.jalz.2014.09.002

Schwarzkopf, L., Menn, P., Kunz, S., Holle, R., Lauterberg, J., Marx, P., . . . Graessel, E. (2011). Costs of care for dementia patients in community setting: an analysis for mild and moderate disease stage. *Value in Health, 14*(6), 827-835. doi: 10.1016/j.jval.2011.04.005

Seelye, A. M., Schmitter-Edgecombe, M., Das, B., & Cook, D. J. (2012). Application of cognitive rehabilitation theory to the development of smart prompting technologies. *IEEE Rev Biomed Eng, 5*, 29-44. doi:10.1109/RBME.2012.2196691

Spijker, A., Teerenstra, S., Wollersheim, H., Adang, E., Verhey, F., & Vernooij-Dassen, M. (2013). Influence of adherence to a systematic care program for caregivers of dementia patients. *The American Journal of Geriatric Psychiatry, 21*(1), 26-36. doi: 10.1016/j.jagp.2012.10.003

Taiwan Alzheimer's Disease Association. (2012). *The report of the estimation of dementia population in Taiwan.* Retrieved from http:// www.tada2002.org.tw/tada _know_02.html#01

Tozlu, M., Cankurtaran, M., Yavuz, B. B., Cankurtaran, E. S., Kutluer, I., Erkek, B. M., . . . Ariogul, S. (2014). Functional disability in Alzheimer disease: a validation study of the Turkish version of the disability assessment for dementia scale. *Journal of Geriatric Psychiatry and Neurology, 27*(4), 237-246. doi: 10.1177/0891988714532014

van Vonderen, A. (2004). Effectiveness of immediate verbal feedback on trainer behaviour during communication training with individuals with intellectual disability. *Journal of Intellectual Disability Research 48*(Pt 3), 245-251. doi: 10.1111/j.1365-2788.2003.00555.x

van Vonderen, A., Duker, P., & Didden, R. (2010). Instruction and video feedback to improve staff's trainer behaviour and response prompting during one-to-one training with young children with severe intellectual disability. *Research in Developmental Disabilities, 31*(6), 1481-1490. doi: 10.1016/j.ridd.2010.06.009

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# 日常照顧技巧於改善失智症患者日常生活功能與照顧者生活品質之成效

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## 摘要

多數的失智症患者都需要照顧者的協助才能完成日常生活活動。此研究的目的在於探討日常生活活動提示訓練對於失智症病患的日常生活活動表現以及照顧者生活品質的影響。

此研究以隨機分派方式進行,33 位阿茲海默型失智症病患(平均 78.8±8.2 歲)與其照顧者參與，接受每月 1 次為期 4 個月的介入訓練或普通照顧訓練，並藉由盥洗、穿衣、購物、服藥這四種日常生活活動擇一作為介入訓練的項目，提供四種結合口語、視覺與手勢的提示介入。本研究使用失智症功能障礙評估量表(Disability Assessment for Dementia, DAD)評估日常生活活動功能的改變，並且以照顧者負擔量表(Caregiver Burden Inventory, CBI)和 SF-36 生活品質量表(36-Item Short-Form Health Survey, SF-36)分別評估照顧者負擔和生活品質。

48 位失智症病患接受初評，接受 4 個月的訓練之後，共 33 位(68.7%)完成後測。相較於控制組（17 人），介入組的患者（16 人）在 DAD 基本日常生活活動(Basic Activities of Daily Living, BADL)項目的退化少且達顯著($p$=0.04)，且其照顧者在 SF-36 的生理項目(Physical Component Summary, PCS)有明顯的進步($p$=0.009)。兩組在 DAD 的工具性日常生活活動(Instrumental Activities of Daily Living, IADL)項目($p$=0.29)、SF-36 的心理項目($p$=0.95)與 CBI ($p$=0.60)則無顯著的改變。

本研究顯示藉由提供提示調整活動需求對於失智症患者的 BADL 障礙以及照顧者的生理健康有立即的成效。此介入方式可做為提供失智症患者與其照顧者服務的參考。

**關鍵字：**日常生活活動，阿茲海默氏症，照顧者

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# 注意力缺陷過動症孩童工作記憶之缺損



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## 摘要

先前的研究顯示注意力缺陷過動症兒童(Attention Deficit/Hyperactivity Disorder，ADHD)有工作記憶的缺損但仍無一致定論，且很少研究探討其工作記憶表現是否會有年齡差異的影響。因此，本研究採傳統神經心理測驗(NEPSY-II)來檢測高、低年級 ADHD 兒童在執行視覺空間與語音訊息兩種類型之工作記憶任務的表現。本研究招募了 68 位在年齡、性別、智力上配對之 ADHD 及典型發展兒童，低年級各 18 位（7.8 ± 0.6 歲），高年級各 16 位（11.6 ± 0.7 歲），分別接受視覺空間與語音訊息類型之神經心理測驗。結果指出 ADHD 兒童在兩種類型之短期記憶及工作記憶大部分的項目上表現都較控制組差。在語音訊息短期記憶測驗中，儘管 ADHD 和控制組間的最高記憶數量並無差異，但 ADHD 組的短期記憶與工作記憶都明顯比控制組不穩定且不佳，顯示 ADHD 兒童中央執行之缺失。此外在 NEPSY-II 上發現 ADHD 兒童在視覺空間長期記憶提取之表現亦有缺損。在兩類工作記憶測驗之記憶數量結果顯示，高年級組多於低年級組，控制組多於 ADHD 組。

本研究結果顯示 ADHD 兒童有工作記憶之缺損，且這樣的缺損不會隨年齡發展而追上同儕。透過了解 ADHD 兒童工作記憶缺損特徵並提供早期適當治療應對其有所助益，本研究也提出相關之應用及建議。

**關鍵字：**注意力缺陷過動症，兒童，工作記憶，年齡相關差異

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# 前言

在第三版職能治療實務架構中 (Occupational Therapy Practice Framework, OTPF) ，工作記憶乃屬於在個案因素的高階認知能力的執行功能中，其缺損會影響個體在短時間內記住訊息及運用訊息的能力，而導致對周遭任務挑戰之反應不佳，使得個案在許多職能領域如教育學習、社會參與等也會受到影響。近年來已有許多研究提到注意力缺陷過動症 (Attention Deficit/Hyperactivity Disorder, ADHD) 兒童有工作記憶缺損，若我們能深入了解其工作記憶缺損及其所造成之影響，可以增加我們對於 ADHD 個案因素的知識並促進臨床人員有證據基礎之推理以訂定合適之治療目標。

工作記憶是一個資源有限的系統，允許我們能夠將外在訊息短暫地儲存在心中並在同時對這些儲存的訊息處理及更新，此外工作記憶也提供一個介面讓知覺訊息和長期記憶之間能夠互動 (Baddeley, 2003)，它包含了以下四個部分：中央執行(central executive, CE)，為一注意力控制器並能協調附屬儲存系統的訊息及連接長期記憶；兩個附屬的短期儲存系統 (storage system)，視覺空間模板 (visuospatial sketch-pad) 及語音迴路 (phonological loop) 會分別對視覺空間類型及語音訊息類型的資訊做短暫時間的儲存；事件緩衝器 (episodic buffer) 提供一個平台讓工作記憶的資訊和長期記憶可以被整合及使用 (Baddeley, 2012)。在本篇研究中，短期記憶或短期儲存的功能乃是能將訊息維持一段時間，而工作記憶的功能乃是能短暫儲存訊息並同時做資訊操作 (Goldstein, 2014)。工作記憶在人們執行複雜認知活動例如推理、理解、學習等過程中扮演了重要角色 (Baddeley, 2010)。兒童工作記憶的功能若不佳，則會產生認知功能的困難或產生行為症狀，像是注意力不集中或健忘、容易粗心犯錯、對自己所從事活動之監控能力的品質不佳等 (Alloway, Gathercole, Kirkwood, & Elliott, 2009)。

注意力缺陷過動症是一個常見於兒童期，且可能會持續至成人期 (Faraone, Biederman, & Mick, 2006)的疾病，常伴有會影響到日常生活之注意力不足與過動衝動行為症狀。近來的數篇研究顯示 ADHD 兒童在工作記憶有所缺損 (Martinussen, Hayden, Hogg-Johnson, &Tannock, 2005; Willcutt, Doyle, Nigg, Faraone,

& Pennington, 2005)，且工作記憶之能力若無法面對環境所帶來之挑戰時也可能會導致注意力不足行為症狀之產生 (Kofler, Rapport, Bolden, Sarver, & Raiker, 2010)。因此，了解 ADHD 的工作記憶表現或許可以更幫助我們去了解其行為特徵及認知表現。先前的研究指出，ADHD 不論是工作記憶或是短期儲存的表現皆較典型發展同儕差；視覺空間類型工作記憶的缺損會比語音訊息類型工作記憶更明顯 (Martinussen et al., 2005)。有學者更細膩的探討 ADHD 的工作記憶缺損，顯示其中央執行的缺損甚於視覺空間類型之短期儲存，而視覺空間類型之短期儲存甚於語音訊息類型之短期儲存 (Rapport et al., 2008)，這說明了中央執行在工作記憶中扮演了一個重要的角色。儘管多數研究支持 ADHD 視覺空間類型的工作記憶的缺損甚於語音訊息類型之工作記憶，但仍有學者發現相反的結果，他們解釋這可能是因為實驗中語音訊息類型工作記憶任務所需要的執行控制資源比視覺空間類型工作記憶任務更多，前者除了儲存訊息還要操作資訊，而後者只需儲存訊息，即語音訊息類型之任務比視覺空間類型之任務難度更難（消耗較多的注意力控制資源），所以才會有這樣的結果 (Brocki, Randall, Bohlin, & Kerns, 2008)。

值得注意的是，過往的研究常較少細分年齡組別去探討年齡因素對 ADHD 工作記憶缺損的影響 (Brocki et al., 2008; Martinussen et al., 2005; Rapport et al., 2008)，因此有關不同年齡層 ADHD 之工作記憶表現的文獻並不多，需要更多被探討。就我們所知，僅有一篇觀察年齡差異是否會對 ADHD 兒童工作記憶造成影響的橫斷面研究 (cross-sectional study)發現，儘管 ADHD 兒童在六至八歲時兩種類型之工作記憶皆較典型發展同儕來的差且視覺空間類型更為缺損，但是在八歲之後 ADHD 兒童的語音類型工作記憶表現和典型發展同儕相比就沒有統計上的顯著差異，而視覺空間類型工作記憶仍有缺損 (Sowerby, Seal, & Tripp, 2011)。該研究的結果強調了年齡不同所帶來的影響，不過，有文獻指出工作記憶能力在八歲左右時有效選擇目標訊息的能力較不完全，約十歲後才有類似成人的表現 (Hale, Bronik, & Fry, 1997)，因此年齡層的分組或許以 10 歲來分組會是更好的方式，這也是本研究與之前的研究不同的地方 (Sowerby et al., 2011)。所以，我們的研究希望更了解年齡對工作記憶產生的影響並更明確的將年齡層分組。

近來的文獻指出 ADHD 兒童有工作記憶缺損，但是哪種類型之工作記憶缺損更明顯之研究結果仍有不一致的地方，此外觀察年齡差異對工作記憶變化影響之研究也不多。因此，本研究有兩個主要的目的，第一是了解 ADHD 兒童在哪種工作記憶類型之缺損更明顯，會選取僅需短期儲存或需要較多資訊操作之測驗來比較兩種類型工作記憶之缺損狀況，並透過效果值的比較更進一步了 ADHD 兒童在那些測驗的表現上會反應出較大的差異量；第二是探討不同年齡層之 ADHD 其工作記憶缺失之狀況，並透過更整體的雙因子變異數分析了解不同因子（診斷組別、年級）是否有交互作用來探討低年級或高年級時，ADHD 兒童與典型發展兒童在兩種類型之工作記憶差異情形為何來探討年齡對工作記憶的影響。先前文獻指出兒童大約十歲後才會有類似成人的工作記憶表現 (Hale, Bronik, & Fry, 1997)，因此本研究對象乃是低年級與高年級兩種不同年齡層的 ADHD 兒童與典型發展兒童。低年級兒童年齡範圍為 6 至 8 歲，高年級兒童年齡範圍為 10 至 12 歲。最後，根據先前多數的研究結果，本研究第一個假設是 ADHD 兒童在各類型工作記憶上面的表現會比典型發展同儕更差，而且視覺空間類型的缺失會更明顯，第二個假設是 ADHD 兒童在視覺空間類型的工作記憶能力不會趕上典型發展同儕之表現，但是語音類型的工作記憶可能會改善而與典型發展同儕相似。

# 方法

## 一、參與對象

本研究依據兒童是否具診斷分為 ADHD 組與控制組，再依據年齡各分為低與高年級兩組，總共四組。低年級與高年級每組分別各有 18 人及 16 人，總共 68 人。控制組透過學校發傳單及家長介紹而來；ADHD 組透過網路社團及相關機構、長庚醫院醫師與治療師、國小老師及家長轉介而來。參與者納入條件如下：若經醫師判斷為 ADHD 或曾有 ADHD 診斷皆會被分類為 ADHD 組。ADHD 組與控制組的納入條件相似如下：（1）生理年齡介於 6 至 8 歲 11 個月或 10 至 12 歲 11 個月；（2）兩眼視力正常或矯正至正常者且非色盲；（3）男性；（4）若有服用藥物者需於實驗前停藥 24 小時；（5）托尼非語文智力測驗 80 分以上。參與者排除條

件如下：（1）癲癇；（2）智能障礙或發展遲緩；（3）自閉症光譜疾患；（4）情感性疾患；（5）器質性腦傷等。

## 二、研究工具

每位參與者的基本資料會透過以下測驗取得：

### *(一) 人口學資料*

（1)愛丁堡慣用手測驗量表 (Oldfield, 1971)，用於了解受試者的慣用手傾向，分數若大於「40」即為慣用右手傾向，若小於「40」即為慣用左手傾向，介於中間則為慣用手不清楚之情形。由於不同類型工作記憶會有偏左側或偏右側的現象(Baddeley, 2003)，為避免優勢腦側化可能帶來的影響，所以會了解兒童的慣用手傾向；(2)托尼非語文智力測驗(吳武典等人，民 96)，用於獲得兒童的智力表現，原始分數可經由國內年齡常模對照表轉換成指數分數，平均為 100，標準差為 15，分數愈高代表智力表現愈好；(3)注意力缺陷過動症中文版量表 (Swanson, Nolan, and Pelhan, Version IV, SNAP-IV)（劉昱志等人，民 95），是一個 4 點量表，每題分數為 0 到 3。注意力不集中與衝動過動之題目各有 9 題，總分各為 0 到 27 分。臨床人員可透過家長對兒童行為之評分來獲得兒童在注意力不集中及衝動過動上面的參考分數，分數愈高代表症狀程度愈大，但是否達到臨床切截點則需對照國內常模，該常模適用於國小至國中的兒童。

### *(二) 視覺空間類型之工作記憶測驗*

（1）自動化工作記憶評量 (Automated Working Memory Assessment, AWMA)是 Alloway (2007)以工作記憶理論編製而成的測驗，適用 4 至 22 歲的人，方塊回憶測驗(Block recall，BR)被用來測量視覺空間短期記憶表現，即資訊儲存功能。空間回憶測驗(Spatial recall, SR)被用來測量視覺空間的工作記憶表現，即資訊儲存與操作功能。分數會分別以國外年齡常模轉換之指數分數呈現，分數愈高代表兒童在視覺空間類型之短期記憶或工作記憶表現愈好，平均為 100，標準差為 15。此外會記錄兒童最高可以記得的數量，分數愈高代表能記得的數量愈多。

（2）NEPSY-II (Korkman, Kirk, & Kemp, 2007) 是一套用於了解 3 至 16 歲兒童神經心理功能之測驗，其中圖形設計－立即記憶 (Memory for Designs, MD) 用於了解對新奇視覺刺激及空間位置的學習能力，又有內容分數 (Content scores, C)、空間分數 (Spatial scores, S) 及兩者之總分 (Total scores, T)，屬辨認類型的短期記憶（儲存）。圖形設計－延宕 (Memory for Designs Delayed, MDD) 用於了解對看過之視覺資訊在一段時間後之長期記憶提取之能力，一樣也有內容分數、空間分數與總分。分數會分別以國外年齡常模轉換之量尺分數呈現，分數愈高代表兒童在視覺空間類型之短期記憶或長期記憶表現愈好，平均為 10，標準差為 3。

### *(三) 語音訊息類型之工作記憶測驗*

魏氏兒童智力測驗第四版的分測驗（陳榮華、陳心怡，民 96a，民 96b），適用 6 至 16 歲的人，記憶廣度分測驗－順序 (Digit Span Forward, DSF) 被用來測量語音訊息的短期記憶表現，即資訊儲存功能。記憶廣度分測驗－逆序 (Digit Span Backward, DSB) 與數字序列分測驗 (Letter Number, LN) 被用來測量語音訊息的工作記憶表現，即資訊儲存與操作功能。分數會分別以國內年齡常模轉換之標準分數呈現，平均為 10，標準差為 3，分數愈高代表兒童在語音訊息短期記憶或工作記憶表現愈好。此外會記錄兒童最高可以記得的數量，分數愈高代表能記得的數量愈多。

## 三、研究程序

本研究由一位經過嚴格訓練的研究人員負責施測及蒐集相關資料，研究人員本身是一位職能治療師，並由另一位資深職能治療師負責督導。父母與孩童會在被告知實驗目的並同意參與後才進行接下來的實驗流程，此外若受試者有任何問題皆可以提出並會得到研究人員的回答和解釋，並在全部測驗結束後獲得兒童禮品與合理車馬費補助。施測過程中，父母會填寫 SNAP-IV 量表，並在旁協助兒童填寫慣用手測驗，其餘測驗皆在安靜、舒適且只有施測人員的環境下施測，然而，少數特殊狀況像是當父母不在身邊兒童會無法以正常表現作答時才會允許父母在

旁陪同，父母則需要在兒童看不到的角落且不能發出任何聲音。整個實驗時間大約為 1 小時至 1.5 小時，且當兒童有需要時中間會提供數次休息。本研究的實驗內容有經過長庚醫院人體試驗委員會審核通過。

## 四、資料分析

本研究以 SPSS 20.0 版 (SPSS Inc., Chicago, IL, United States) 進行統計分析，顯著水平設為 $p < 0.05$。描述性資料以平均數 ± 標準差表示，包含生理年齡、智力商數、慣用手商數、SNAP-IV 注意力不集中與過動衝動分數等。推論性統計則以雙因子變異數分析 (Two-way Analysis of Variance) 來分析不同診斷組別、不同年級之兒童之工作記憶表現如何，若某測驗項目具有交互作用 (interaction effect) 則會進一步進行單純主效果 (simple main effect) 的分析。若沒有交互作用則直接觀察是否有哪一因子有統計上之顯著差異狀況。效果值以 SPSS 所輸出之 $\eta_p^2$ 表示。

# 結果

本研究收入 68 位低年級與高年級之 ADHD 組與典型發展控制組男童，其中除了高年級控制組沒有慣用左手者，其他組別各一位。ADHD 男童有用藥者共 21 人，服用「利他能」與「專司達」各為 11 和 6 位，有 4 位兒童是兩者都服用過；控制組男童無人服用特殊藥物。SNAP-IV 量表分數達切截點狀況如下：ADHD 男童注意力不集中、衝動過動皆有者共 12 位，低與高年級分別為 8 和 4 位；ADHD 男童注意力不集中者共 4 位，低與高年級分別為 1 和 3 位；ADHD 男童衝動過動者共 4 位，低與高年級各 2 位。所有低年級男童平均年齡為 7.8 ± 0.6 歲，所有高年級男童平均年齡為 11.6 ± 0.7 歲。

## 一、人口學資料

關於基本人口學資料之描述性統計請見表 1，雙因子變異數分析結果請見表 2。結果顯示在智商、慣用手部分沒有任何統計上的顯著結果，即 ADHD 與控制組兒

童或低與高年級兒童在智商與慣用手程度之比較上沒有顯著差異。生理年齡上診斷組別因子沒有顯著差異，有年級因子的顯著差異。在 SNAP-IV 量表上，注意力不集中項目僅有診斷組別因子之顯著差異，衝動過動項目有診斷組別因子及年級因子的顯著差異，即 ADHD 兒童在注意力不集中、衝動過動項目上之分數顯著高於控制組兒童。低與高年級兒童在注意力不集中項目上無顯著差異，但低年級衝動過動項目上分數顯著高於高年級兒童。

**表 1**
四組兒童在人口學資料之敘述性結果

| 項目 | 低年級 | | 高年級 | |
|---|---|---|---|---|
| | ADHD (*n* = 18) | 控制組 (*n* = 18) | ADHD (*n* = 16) | 控制組 (*n* = 16) |
| 生理年齡(年) | 7.6±0.5 | 7.9±0.6 | 11.4±0.6 | 11.8±0.8 |
| TONI | 102±13 | 103±14 | 103±12 | 111±16 |
| 慣用手傾向商數(%) | 72±43 | 79±27 | 75±35 | 74±43 |
| Inattention | 17.3±6.2 | 9.7±4.5 | 16.4±5 | 6.4±4.3 |
| Impulsivity | 16.3±6.2 | 7.3±3.9 | 12.4±5.1 | 4.3±4.1 |

TONI：尼非語文智力測驗第三版；Inattention：SNAP-IV 注意力不集中；Impulsivity：SNAP-IV 衝動過動

**表 2**
人口學資料之雙因子變異數分析結果

| 項目\因子 | 診斷 $df = (1,64)$ | | | 年齡 $df = (1,64)$ | | | 診斷 × 年齡 $df = (1,64)$ | | |
|---|---|---|---|---|---|---|---|---|---|
| | $F$ | $p$ | $\eta_p^2$ | $F$ | $p$ | $\eta_p^2$ | $F$ | $p$ | $\eta_p^2$ |
| 生理年齡(年) | 3.89 | 0.053 | 0.057 | 635.58 | <0.001 | 0.909 | 0.25 | 0.616 | 0.004 |
| TONI | 1.63 | 0.206 | 0.018 | 1.78 | 0.187 | 0.005 | 1.19 | 0.279 | 0.001 |
| 慣用手程度 | 1.16 | 0.287 | 0.025 | 0.34 | 0.560 | 0.027 | 0.05 | 0.824 | 0.018 |
| Inattention | 50.55 | <0.001 | 0.441 | 2.96 | 0.090 | 0.044 | 0.98 | 0.326 | 0.015 |
| Impulsivity | 51.67 | <0.001 | 0.447 | 8.54** | 0.005 | 0.118 | 0.15 | 0.698 | 0.002 |

TONI：托尼非語文智力測驗第三版；Inattention：SNAP-IV 注意力不集中；Impulsivity：SNAP-IV 衝動過動

## 二、視覺空間類型之工作記憶測驗

檢測視覺空間類型工作記憶測驗之自動化工作記憶評量及 NEPSY-II 項目中之描述性統計請見表 3。雙因子變異數分析結果請見表 4，在所有項目均沒有交互

作用顯著之情形。在自動化工作記憶評量中，方塊回憶測驗、方塊回憶測驗最高記憶量、空間回憶測驗、空間回憶測驗最高記憶量皆有診斷組別因子之顯著差異，即 ADHD 兒童在這些項目的分數上顯著比控制組兒童低。除了方塊回憶測驗之外，方塊回憶測驗最高記憶量、空間回憶測驗、空間回憶測驗最高記憶量皆有年級因子的顯著差異，即除了方塊回憶測驗的項目外，低年級兒童分數顯著比高年級兒童低。

在 NPESY-II 立即記憶項目上無任何統計上的顯著差異，即 ADHD 與控制組兒童之間或低年級與高年級兒童之間在立即記憶項目上無顯著差異。在延宕記憶項目上的內容分數及總分分數有診斷組別因子的顯著差異，空間分數有年級因子的顯著差異，即在內容分數及總分分數項目中 ADHD 兒童之分數顯著比控制組兒童低；在空間分數項目上低年級兒童分數顯著比高年級低。

**表 3**

四組兒童在視覺空間類型工作記憶測驗之敘述性結果

| | 低年級 | | 高年級 | |
|---|---|---|---|---|
| | ADHD ($n$ = 18) | 控制組 ($n$= 18) | ADHD ($n$ = 16) | 控制組 ($n$ = 16) |
| AWMA | | | | |
| BR | 100±15 | 109±14 | 104±12 | 116±11 |
| BR-HM | 3.7±0.7 | 4.2±0.8 | 5.1±0.9 | 5.9±0.6 |
| SR | 106±12 | 120±11 | 119±12 | 125±15 |
| SR-HM | 3.1±0.9 | 3.9±0.7 | 5±0.8 | 5.4±1 |
| NEPSY-II | | | | |
| MD-C | 9.4±2.2 | 10.1±2.5 | 9.5±3.2 | 11.1±2.7 |
| MD-S | 10.3±2.7 | 11.2±2.3 | 10.7±3.2 | 11.4±2.1 |
| MD-T | 9.4±2.4 | 10.4±2.1 | 9.7±3.1 | 10.8±2.8 |
| MDD-C | 10±2.3 | 10.9±2.7 | 8.9±2.9 | 10.9±2 |
| MDD-S | 9.9±2.2 | 11.1±2.2 | 12.4±1.7 | 12.4±1.7 |
| MDD-T | 10±2.3 | 11.2±2.6 | 9.9±2.7 | 11.2±2 |

AWMA：自動化工作記憶評量； BR：方塊回憶；BR-HM：方塊回憶測驗最高記憶量；SR：空間回憶；SR-HM：空間回憶測驗最高記憶量；MD：圖形設計立即記憶；MDD：圖形設計延宕記憶；-C：內容分數；-S：空間分數；-T：總分

**表 4**
視覺空間類型工作記憶測驗之雙因子變異數分析結果

| | 診斷 $df = (1,64)$ | | | 年齡 $df = (1,64)$ | | | 診斷 × 年齡 $df = (1,64)$ | | |
|---|---|---|---|---|---|---|---|---|---|
| | $F$ | $p$ | $\eta_p^2$ | $F$ | $p$ | $\eta_p^2$ | $F$ | $p$ | $\eta_p^2$ |
| AWMA | | | | | | | | | |
| BR | 10.18 | 0.002 | 0.137 | 2.62 | 0.110 | 0.039 | 0.19 | 0.661 | 0.003 |
| BR-HM | 11.76 | 0.001 | 0.155 | 75.50 | <0.001 | 0.541 | 0.47 | 0.495 | 0.007 |
| SR | 10.53 | 0.002 | 0.141 | 7.74 | 0.007 | 0.108 | 1.69 | 0.198 | 0.026 |
| SR-HM | 8.52 | 0.005 | 0.117 | 68.64 | <0.001 | 0.518 | 1.23 | 0.272 | 0.019 |
| NEPSY-II | | | | | | | | | |
| MD-C | 3.16 | 0.080 | 0.047 | 0.84 | 0.363 | 0.013 | 0.55 | 0.460 | 0.009 |
| MD-S | 1.68 | 0.199 | 0.026 | 0.20 | 0.654 | 0.003 | 0.01 | 0.913 | <0.001 |
| MD-T | 2.70 | 0.106 | 0.040 | 0.28 | 0.599 | 0.004 | 0.02 | 0.887 | <0.001 |
| MDD-C | 5.81* | 0.019 | 0.083 | 0.96 | 0.332 | 0.015 | 0.75 | 0.391 | 0.012 |
| MDD-S | 1.45 | 0.233 | 0.022 | 15.44 | <0.001 | 0.194 | 1.45 | 0.233 | 0.022 |
| MDD-T | 4.59* | 0.036 | 0.067 | 0.02 | 0.893 | <0.001 | 0.01 | 0.939 | < 0.001 |

AWMA：自動化工作記憶評量；BR：方塊回憶；BR-HM：方塊回憶測驗最高記憶量；SR：空間回憶；SR-HM：空間回憶測驗最高記憶量；MD：圖形設計立即記憶；MDD：圖形設計延宕記憶；-C：內容分數；-S：空間分數；-T：總分

## 三、語音訊息類型之工作記憶測驗

檢測語音訊息類型工作記憶測驗之魏氏兒童智力測驗第四版的分測驗項目之描述性統計請見表 5，雙因子變異數分析結果請見表 6，在所有項目均沒有交互作用顯著之情形。在數字廣度順序測驗、數字廣度逆序測驗、數字廣度順序測驗最高記憶量、數字測驗、數字測驗最高記憶量有診斷組別因子的顯著差異，僅數字廣度順序測驗最高記憶量無顯著差異，即除了數字廣度順序測驗最高記憶量外的其他項目中 ADHD 兒童的分數顯著比控制組兒童低。在數字廣度順序測驗最高記憶量、數字廣度順序測驗最高記憶量、數字測驗最高記憶量有年級因子的顯著差異，其餘項目無，即在這些項目中低年級兒童的分數顯著比高年級兒童低。

關於各類型工作記憶測驗項目之效果值數據的呈現，數字廣度逆序測驗(DSB, $\eta_p^2$ ＝ .216)的效果值最大，其次是空間回憶測驗 (SR, $\eta_p^2$ ＝ 0.141)、方塊回憶測驗

(BR, $\eta_p^2 = 0.137$)、數字序列測驗 (LN, $\eta_p^2 = 0.130$)，最後是數字廣度順序測驗 (DSF, $\eta_p^2 = 0.110$)。

**表 5**
四組兒童在語音訊息類型工作記憶之敘述性結果

| | 低年級 | | 高年級 | |
|---|---|---|---|---|
| | ADHD ($n$ =18) | 控制組 ($n$ =18) | ADHD ($n$ = 16) | 控制組 ($n$ = 16) |
| 數字廣度測驗 | | | | |
| DSF | 8.7± 2.2 | 9.6±2.7 | 7.8±2.8 | 10.7±3.3 |
| DSF-HM | 6.8±0.9 | 7±1.3 | 7.6±1.2 | 8.4±0.9 |
| DSB | 9±1.8 | 10.5±3.4 | 8.5±2.1 | 12.4±3 |
| DSB-HM | 3.1±0.8 | 3.8±1.4 | 4.4±1.1 | 6.2±1.4 |
| 數字序列測驗 | | | | |
| LN | 9.8±3.2 | 12.1±2.6 | 10.3± 1.2 | 11.6±2.1 |
| LN-HM | 3.5±0.9 | 4.5±1.1 | 5.6±1 | 6.1±1 |

DSF：數字廣度順序；DSF-HM：數字廣度順序最高記憶量；DSB：數字廣度逆序；DSB-HM：數字廣度逆序最高記憶量；LN：數字序列；LN-HM：數字序列最高記憶量

**表 6**
語音訊息類型工作記憶測驗之雙因子變異數分析結果

| | 診斷 | | | 年齡 | | | 診斷 × 年齡 | | |
|---|---|---|---|---|---|---|---|---|---|
| | $df = (1,64)$ | | | $df = (1,64)$ | | | $df = (1,64)$ | | |
| | $F$ | $p$ | $\eta_p^2$ | $F$ | $p$ | $\eta_p^2$ | $F$ | $p$ | $\eta_p^2$ |
| 數字廣度測驗 | | | | | | | | | |
| DSF | 7.90 | 0.007 | 0.110 | 0.04 | 0.836 | <0.001 | 2.20 | 0.143 | 0.033 |
| DSF-HM | 3.60 | 0.062 | 0.053 | 16.63 | <0.001 | 0.206 | 1.57 | 0.215 | 0.024 |
| DSB | 17.63 | <0.001 | 0.216 | 1.15 | 0.287 | 0.018 | 3.44 | 0.068 | 0.051 |
| DSB-HM | 17.35 | <0.001 | 0.213 | 41.46 | <0.001 | 0.393 | 3.49 | 0.066 | 0.052 |
| 數字序列測驗 | | | | | | | | | |
| LN | 9.60 | 0.003 | 0.130 | 0.00 | 0.972 | <0.001 | 0.59 | 0.447 | 0.009 |
| LN-HM | 9.76 | 0.003 | 0.132 | 60.99 | <0.001 | 0.488 | 1.08 | 0.302 | 0.017 |

DSF：數字廣度順序；DSF-HM：數字廣度順序最高記憶量；DSB：數字廣度逆序；DSB-HM：數字廣度逆序最高記憶量；LN：數字序列；LN-HM：數字序列最高記憶量

# 討論

本研究的目的為藉著神經心理測驗探討 ADHD 與控制組兒童在不同類型之工作記憶表現上的差異與狀況，並觀察這樣的差異是否會因為年級不同而有所改變。本研究有兩點主要發現：第一，結果顯示 ADHD 兒童在視覺空間類型和語音訊息類型之工作記憶表現上普遍比控制組兒童差，然而，從不同測驗項目之效果值大小做比較時可發現視覺空間類型之工作記憶缺損並無一致地比語音訊息類型之工作記憶缺損更明顯，與先前研究之結果有所不同 (Martinussen et al., 2005)。第二，ADHD 兒童在兩種類型之工作記憶表現上雖然會因年齡成長而進步，但是仍無法追上同儕控制組的表現。儘管先前的研究 (Sowerby et al., 2011) 認為語音訊息類型之工作記憶缺損會隨著年齡成長而漸漸變好，但本研究的結果發現高年級 ADHD 兒童在語音訊息類型工作記憶之表現仍然比典型發展同儕差。

關於人口學資料的呈現，ADHD 與控制組兒童在智力、年齡、慣用手商數之表現上皆沒有達到診斷組別上的顯著差異。低年級與高年級兒童在智力、慣用手商數、注意力不集中項目上沒有差異，不過，在衝動過動項目上有年級因子的顯著差異，高年級整體的衝動過動行為會比低年級少。對照先前研究，Biederman 等 (2000) 以 ADHD 為研究對象並探討其行為症狀會如何地受年齡因素影響，結果發現年齡愈大時，衝動過動的症狀會減少並趨緩，但關於注意力不足的症狀，雖然有趨緩可是程度並不多。這樣的發現也與本研究類似，結果顯示不論是 ADHD 或是典型發展兒童在低年級時的衝動過動表現皆較大，而隨著年齡增長，衝動過動症狀有顯著減緩的趨勢。關於注意力不足的症狀雖然可以看出有減緩，但卻沒有達到統計上的顯著差異。

關於視覺空間類型工作記憶之測驗，本研究結果顯示，ADHD 組兒童的工作記憶表現一致地比控制組兒童差，與過去文獻的結果一致 (Martinussen et al., 2005; Willcutt et al., 2005)。此外本研究結果有三點有趣的發現，第一，儘管在自動化工作記憶評量上 ADHD 組一致地比控制組表現較差，但是在 NEPSY-II 測驗中的立即回憶項目上兩組就沒有差異，不過，這可能是 NEPSY-II 中的圖形設計測驗偏向記憶辨認 (recognition) 類型，而非記憶回想 (recall) 類型之緣故。相較於在記憶

提取時有線索可循的辨認測驗，回想測驗要求兒童在沒有線索的狀況下去進行回憶及作答，或許，ADHD 組兒童的表現也因而沒有比較差，這樣的結果也與 Keage 等人 (2006) 提到之內容類似，他們發現在辨認測驗上 ADHD 組與控制組表現相似，但是在回想測驗上就顯出差異。第二，ADHD 兒童特別在新奇視覺刺激內容之長期記憶提取能力（延宕內容分數）上面較控制組兒童差，空間內容（延宕空間分數）之長期記憶提取能力則與控制組兒童相仿。這是個值得注意的事情，因為只有在新奇視覺刺激內容上面有差異，可能是任務性質不同所導致：在新奇視覺刺激的記憶上面會有目標及干擾兩類卡片，在處理上會較複雜，可能就對於 ADHD 兒童長期記憶的鞏固和提取造成挑戰。相反地，空間記憶只要正確將卡片放到同樣位置即可。不論如何，結果顯示 ADHD 有視覺長期記憶缺損和先前研究一致 (Yáñez-Téllez et al., 2012)。第三，本研究顯示 ADHD 兒童在自動化工作記憶評量裏的空間與方塊測驗之最高記憶量會隨年齡與年級增加而進步，但仍無法追上同齡配對控制組，這與 Sowerby 等人 (2011) 研究結果相同，即 ADHD 視覺空間之工作記憶缺損「並不會隨年齡增加而追上控制組」。值得注意的是，空間回憶測驗 (SR) 、延宕配對－空間 (MDDS) 這兩項目是經過年齡校正轉換之分數，但整體兒童之分數表現仍可看出有隨著年齡增加而進步，可能是在同樣難度標準下年齡較大的兒童會運用更多策略運用所導致，如運用語音訊息的編碼方式來輔助作答。雖然是以外國常模對照，但因其內容並不牽涉語言與文化，應該仍適用，並且診斷組別的統計結果有差異，這也與先前研究結果相同。然而高年級兒童（不論 ADHD 或典型發展兒童）之整體表現比低年級兒童更好，是否為高年級兒童運用之策略改變所致，這仍需進一步研究來澄清。

關於語音訊息類型工作記憶之測驗，本研究結果顯示，儘管 ADHD 組兒童的整體工作記憶表現比控制組兒童差的結果與先前研究 (Martinussen et al., 2005) 一致，但並沒有所有項目都有差異，如「順序測驗之最高記憶量 (DSF-HM)」在 ADHD 組和控制組的表現相似。這沒有組別差異的項目屬於機械式學習與記憶之短期儲存的部分，量測是否曾完成某記憶數量。相反地，雖然「順序測驗標準分數 (DSF)」之項目也屬於短期儲存，但是結果卻有顯著差異。這可能是受試者除了需要儲存能力，也需要相當的注意力表現才能夠穩定答對且產出有品質的表現，即 ADHD

可能有能力完成測驗的題目，但卻不能持續專注於題目而造成部分題目之作答不佳。因此，在這兩項短期記憶的測量之差異有可能意味著中央執行成分之缺損在影響 ADHD 組兒童表現上有不小的影響 (Rapport et al., 2008)，即 ADHD 組兒童雖在語音訊息之純粹儲存能力上沒有顯著差異，但是 ADHD 組兒童在持續維持專注力以至於能產出有品質反應之表現上可能仍較差。此外本研究發現 ADHD 組兒童的語音訊息類型之工作記憶並不會因年齡增加而有追上控制組同儕的趨勢，如在數字廣度逆序最高記憶量 (DSB-HM) 與數字序列之最高記憶量 (LN-HM) 表現上所有兒童皆會因年齡成長而進步，但 ADHD 相較於同儕表現普遍仍較差，這與 Sowerby 等人 (2011) 認為語音訊息類型之工作記憶應會隨年齡成長而改善之看法不一致。這樣的結果可能是因為本研究所選之測驗會對兒童的執行控制資源有更高的要求，如同 Brocki 等人(2008)認為任務之執行控制資源要求會對工作記憶表現有更大影響之看法，也因此到了高年級 ADHD 組與典型發展控制組仍然有差異。

整體來說兩類型之工作記憶都有缺陷，但沒有完全符合視覺空間類型之工作記憶缺損甚於語音訊息類型之工作記憶之結果 (Martinussen et al., 2005)。這樣的結果可能有幾點原因，首先，本研究所選用之語音訊息類型工作記憶測驗對兒童要求之執行控制資源較其他測驗更多，因此對 ADHD 兒童造成的難度也更大，符合 Brocki 等人 (2008) 的研究發現。然而，自動化工作記憶評量的分測驗目前尚無本地常模，因此只能對照國外常模，或許兒童的表現因而受到文化之影響並導致 ADHD 與典型發展組之間的效果值差異並沒有那麼大，只是這樣的推論需要在未來更進一步澄清。

雖然本研究將工作記憶與短期記憶在定義上有明確區分並作為根據選擇數種測驗，也提供效果值做為參考，但有以下幾點限制需要注意：第一，本研究並沒有特定將 ADHD 做表現型分類，因此可能會忽略不同表現型對兒童表現的影響。不過，先前有研究指出不論是注意力不集中型和合併型，工作記憶的缺損應該都是明確的 (Keage et al., 2006) ，因此在工作記憶表現之解釋上或許不會受到太大影響，但仍必須謹慎地按照兒童的特性來解釋之。第二，本研究無法如同縱貫性研究

直接地提供兒童在發展過程中工作記憶表現上的變化趨勢，因此在解釋上仍需要謹慎看待之。

## 結論與建議

不同類型的工作記憶缺損會造成不同的影響，視覺空間類型的工作記憶和空間位置、影像、動作有關，語音訊息類型的工作記憶和語言學習、閱讀有關 (Alloway, 2007; Baddeley, 2012)。對於兒童來說，若在這些基礎能力上面遇到問題則會影響到兒童在教育學習及社會參與的職能表現，因此需要更多了解。本研究之若干結果應可供臨床人員參考及應用如下：

（1）ADHD 兒童在視覺空間類型或語音訊息類型之工作記憶表現都有缺損，因此兩種類型皆需要被關注而不是只側重某類型的訓練，或者就能提升 ADHD 兒童在學習、理解等高階認知能力的表現。根據研究者的經驗，臨床上通常較強調視覺空間的工作記憶缺損，然而語音訊息的工作記憶缺損仍需被注意，且這可能也會影響到語言學習及學業表現等面向 (Gremillion & Martel, 2012)。因此，使用不同類型及材料之工作記訓練應該會有所助益。

（2）ADHD 工作記憶的表現儘管會隨著年齡進步，但是與典型發展同儕相比仍然有較差的表現。因此及早介入與注意每階段之變化或能減緩 ADHD 兒童因為工作記憶表現缺損而遭受的學習困難。有研究也提到注意力不集中症狀、執行功能之缺乏可能和 ADHD 兒童更容易比典型發展兒童在學業表現上遇到困難有關 (Daley & Birchwood, 2010)。

（3）ADHD 在長期記憶之表現有比典型發展同儕較差的趨勢。根據 Baddeley (2003) 的理論，工作記憶的資訊會和長期記憶的資訊整合並被使用，因此建議在臨床上可以注意兒童在長期記憶之表現是否有較差，也可以詢問父母兒童在這方面的表現為何。若發現有較差之情形，則建議可以教導認知策略及記憶術來促進兒童在長期記憶提取之表現，實用的策略如提取練習 (retrieval practice)，在 5 至 7 次的反覆練習後兒童在往後長期記憶提取上會有較好的表現。提供參考原則如下：兒童接收完某訊息後，用測驗的方法來詢問兒童，並根據兒童的表現給予正確回饋。每次提取練習之間的時間間隔不能太短，如間隔 1 分鐘和間隔 6 分鐘，後者

的記憶效果會較好 (Roediger & Butler, 2011)。這樣的方法亦可以應用在學校及家庭等生活場域當中，以增進訓練的頻率。

（4）根據個案特質及針對任務作不同難易度的設計（如任務改造、指令改造）可以給予更為適性的挑戰及支持 (Daley & Birchwood, 2010)，或許也因而能促進兒童在這方面的復健成效，如記憶類型是辨認或是回想類型就會對兒童造成不同之難易度。可以參考工作記憶模型之內容去針對活動本質作分析及改造，如活動是否會消耗過多的執行控制資源（中央執行），或是需要記憶的數量太多（短期儲存）。

透過了解 ADHD 兒童問題的本質，才能適當地給予需要的協助、陪伴並設計具有目的性及具意義性的活動來協助 ADHD 兒童及其家庭。

# 參考文獻


吳武典、胡心慈、蔡崇建、王振德、林幸台、郭靜姿（民 95）。**托尼非語文智力測驗指導手冊**（再版）。臺北市：心理。

陳榮華、陳心怡（民 96a）。**魏氏兒童智力量表第四版指導手冊**（中文版）。臺北市：中國行為科學社。

陳榮華、陳心怡（民 96b）。**魏氏兒童智力量表第四版技術和解釋手冊**（中文版）。臺北市：中國行為科學社。

劉昱志、劉士愷、商志雍、林建禾、杜長臨、高淑芬（民 95）。注意力缺陷過動症中文版 Swanson, Nolan, and Pelhan, Version IV(SNAP-IV) 量表之常模及信效度。**台灣精神醫學，20**，290-304。

Alloway, T.P. (2007). *Automated Working Memory Assessment: Manual*. London: Pearson Assessment.

Alloway, T. P., Gathercole, S. E., Kirkwood, H., & Elliott, J. (2009). The cognitive and behavioral characteristics of children with low working memory. *Child Development, 80,* 606-621.

Baddeley, A. (2003). Working memory: Looking back and looking forward. *Nature reviews neuroscience, 4,* 829-839.

Baddeley, A. (2010). Working memory. *Current Biology, 20,* R136-R140.

Baddeley, A. (2012). Working memory: theories, models, and controversies. *Annual Review of Psychology, 63,* 1-29.

Biederman, J., Mick, E., &Faraone, S. V. (2000). Age-dependent decline of symptoms of attention deficit hyperactivity disorder: Impact of remission definition and symptom type. *American Journal of Psychiatry, 157,* 816-818.

Brocki, K. C., Randall, K. D., Bohlin, G., & Kerns, K. A. (2008). Working memory in school-aged children with attention-deficit/hyperactivity disorder combined type: Are deficits modality specific and are they independent of impaired inhibitory control? *Journal of Clinical and Experimental Neuropsychology, 30,* 749-759.

Daley, D., & Birchwood, J. (2010). ADHD and academic performance: Why does ADHD impact on academic performance and what can be done to support ADHD children in the classroom? *Child Care Health and Development, 36,* 455-464.

Faraone, S. V., Biederman, J., & Mick, E. (2006). The age-dependent decline of attention deficit hyperactivity disorder: A meta-analysis of follow-up studies. *Psychological Medicine, 36,* 159-165.

Goldstein, E. (2014). *Cognitive psychology: Connecting mind, research and everyday experience Shor-Term and Working Memory* (4th ed., pp. 138-141): Cengage Learning.

Gremillion, M. L., & Martel, M. M. (2012). Semantic language as a mechanism explaining the association between ADHD symptoms and reading and mathematics underachievement. *Journal of Abnormal Child Psychology, 40,* 1339-1349.

Hale, S., Bronik, M. D., & Fry, A. F. (1997). Verbal and spatial working memory in school-age children: Developmental differences in susceptibility to interference. *Developmental Psychology, 33,* 364.

Keage, H. A., Clark, C. R., Hermens, D. F., Kohn, M. R., Clarke, S., Williams, L. M., . . . Gordon, E. (2006). Distractibility in AD/HD predominantly inattentive and combined subtypes: The P3a ERP component, heart rate and performance. *Journal of Integrative Neuroscience, 5,* 139-158.

Kofler, M. J., Rapport, M. D., Bolden, J., Sarver, D. E., & Raiker, J. S. (2010). ADHD and working memory: The impact of central executive deficits and exceeding storage/rehearsal capacity on observed inattentive behavior. *Journal of Abnormal Child Psychology, 38,* 149-161.

Korkman, M., Kirk, U., & Kemp, S. (2007). *NEPSY-II*: Pearson San Antonio, TX.

Martinussen, R., Hayden, J., Hogg-Johnson, S., & Tannock, R. (2005). A meta-analysis of working memory impairments in children with attention-deficit/hyperactivity disorder. *Journal of the American Academy of Child & Adolescent Psychiatry, 44,* 377-384.

Rapport, M., Alderson, R. M., Kofler, M., Sarver, D., Bolden, J., & Sims, V. (2008). Working memory deficits in boys with attention-deficit/hyperactivity disorder (ADHD): The contribution of central executive and subsystem processes. *Journal of Abnormal Child Psychology, 36,* 825-837.

Roediger, H. L., & Butler, A. C. (2011). The critical role of retrieval practice in long-term retention. *Trends in Cognitive Sciences*, 15, 20-27.

Sowerby, P., Seal, S., & Tripp, G. (2011). Working memory deficits in ADHD: the contribution of age, learning/language difficulties, and task parameters. *Jouranl of Attention Disorder, 15,* 461-472.

Willcutt, E. G., Doyle, A. E., Nigg, J. T., Faraone, S. V., & Pennington, B. F. (2005). Validity of the executive function theory of attention-deficit/hyperactivity disorder: A meta-analytic review. *Biological Psychiatry, 57,* 1336-1346.

Yáñez-Téllez, G., Romero-Romero, H., Rivera-García, L., Prieto-Corona, B., Bernal-Hernández, J., Marosi-Holczberger, E., . . . Silva-Pereyra, J. F. (2012). Cognitive and executive functions in ADHD. *ActasEspañolas de Psiquiatría, 40,* 293-298.

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CME/Original article

# Working Memory Deficits in Children with Attention-Deficit/Hyperactivity Disorder

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## Abstract

Previous studies indicated that children with Attention Deficit/Hyperactivity Disorder (ADHD) have deficits of working memory (WM), but the findings were inconsistent. Little is known about the age-related changes of WM in ADHD. Therefore, we investigated performance in children with ADHD while they performed visuospatial/phonological WM tasks across different age groups by using psychological assessments (PA).

We recruited 34 children with ADHD and 34 controls, who were matched in age, gender and intelligence quotient (IQ). There were 18 participants in each young group (7.8 ± 0.6 years) and 16 participants in each old group (11.6 ± 0.7 years). Every child accomplished both visuospatial/phonological PA.

Results showed short-term memory (STM) and WM deficits in children with ADHD in both types of tasks. In the phonological STM task, although there were no significant differences in memory size between the ADHD and control groups, the ADHD group performed less stable and less well than the control group, suggesting central executive deficits in children with ADHD. In addition, deficits in memory retrieval of visuospatial long-term memory (LTM) were found in children with ADHD. In both types of tasks, the old group had bigger memory size than the young group, and the control group had bigger memory size than the ADHD group.

Our findings revealed that children with ADHD had WM deficits and didn't catch up with their peers later. It might be helpful to identify the characteristics of WM deficits in children with ADHD and provide appropriate interventions.

**Keywords:** *ADHD, Age-related difference, Children, Working Memory*

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# Immediate Effects of Laterally-Wedged Insoles with Arch Support on Dynamic Stability During Level Walking in People with Medial Knee Osteoarthritis

OCCUPATIONAL THERAPY

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## Abstract

**Objective:** This study aimed to investigate the immediate effects of laterally-wedged insoles with arch support (LWAS) on dynamic stability during level walking in people with bilateral medial knee osteoarthritis (OA).

**Methods:** Fifteen women with bilateral medial knee OA and 15 healthy control subjects were recruited. A 6-camera motion analysis system and 2 forceplates were used to record the kinematic data and ground reaction force when subjects walked with LWAS. The inclination angles (IA) and the rate of change of IA (RCIA), representing the relative distance and velocity between the body's center of mass and the center of pressure, were calculated for evaluating changes in dynamic stability.

**Results:** Wearing LWAS decreased the IA and RCIA in the anterior-posterior (A/P) direction. In the medial-lateral (M/L) direction, the IA during transition from single leg stance to double leg stance was greater.

**Conclusion:** For people with bilateral medial knee OA, the LWAS may improve A/P dynamic stability during level walking; however, the increased demand in maintenance of M/L dynamic stability was found. Thus, it is suggested that the balance training program might be required for user of LWAS to improve balance, and the effects of LWAS on other locomotion with more difficulty than level walking, such as obstacle crossing and uphill walking, should be addressed in future studies.

***Keywords:*** *Dynamic Stability, Knee Osteoarthritis, Laterally-Wedged Insoles*

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# 1. Introduction

Medial knee osteoarthritis (OA), the most common degenerative disease in middle-aged and older adults, induces knee pain and disturbs physical function (Yildiz et al., 2010), and it often results in falls (Leveille et al., 2002), a major cause of death for older people (Hoyert, Arias, Smith, Murphy, & Kochanek, 2001). It has been reported that laterally-wedged insoles with arch support (LWAS) reduces internal knee abductor moments and knee pain after immediate and long-term usage (Hsu et al., 2015; Yeh et al., 2014). However, the effects of LWAS on dynamic stability remain unclear.

Gait analysis of people with conditions that disturb gait, such as knee OA, have mainly focused on alteration of the joint mechanics of locomotor system during level walking (Gök, Ergin, & Yavuzer, 2002; Huang, Wei, et al., 2008; Hurwitz, Ryals, Case, Block, & Andriacchi, 2002; Annegret Mündermann, Dyrby, & Andriacchi, 2005; Anne Mündermann, Dyrby, Hurwitz, Sharma, & Andriacchi, 2004). However, the findings of those studies do not apply to dynamic stability during level walking. Some studies have used the motion of the body center of mass (COM), and its position respect to the center of pressure (COP) or supporting foot to represent dynamic stability during human locomotion (Chou, Kaufman, Brey, & Draganich, 2001; Chou, Kaufman, Hahn, & Brey, 2003). Greater displacement of the COM or greater distance between the COM and the COP may indicate that the demands of maintaining dynamic stability are increased. However, these variables might have inter-subject variability due to differences in each subject's stature

(Berger, Trippel, Discher, & Dietz, 1992). In order to remove this variation, COM-COP inclination angles (IA), the angles formed by the vertical line and the line connecting the COP and COM, and the rate of change of IA (RCIA) have been used to assess dynamic control during human locomotion (Chien, Lu, & Liu, 2014; Hong et al., 2015; Hsu et al., 2010). The IA represents the spatial relationship between the COM and COP, and the RCIA represents the velocity of the COM respect to the COP; thus, the greater IA as well as the greater RCIA with opposite direction toward the COP may indicate a risk of falls. To prevent falls, dynamic stability should be maintained by both the appropriate COM position respect to the COP and a range of COM velocities (Pai & Patton, 1997). Hsu et al. found that the posterior location of the COM respect to the COP at the beginning of leading single leg stance might require a greater anterior COM velocity for maintaining dynamic stability during obstacle crossing (Hsu et al., 2010). Addressing not only the positions of the COM and COP but also their velocities provides a better description of dynamic control of the human body (Chien, Lu, & Liu, 2013; Chien et al., 2014; Hong et al., 2015; Hsu et al., 2010; Huang, Lu, Chen, Wang, & Chou, 2008).

Past studies that addressed the effects of laterally-wedged insoles in people with knee OA have mainly focused on joint mechanics and spatiotemporal parameters. Internal knee abductor moments have been the primary outcome parameter due to their high correlation to compressive medial compartment loads (Zhao et al., 2007), the leading cause of knee OA, and to knee pain, OA severity, and rate of progression (Anne Mündermann et al., 2004; Miyazaki et al., 2002). These studies have shown the positive effects of wearing laterally-wedged insoles on reducing peak internal knee abductor moments (Butler, Barrios, Royer, & Davis, 2009; Hinman, Bowles, Metcalf, Wrigley, & Bennell, 2012; Hinman, Bowles, Payne, & Bennell, 2008; Hsu et al., 2015; Kakihana, Akai, Nakazawa, Naito, & Torii, 2007; Schmalz, Blumentritt, Drewitz, & Freslier, 2006; Shimada et al., 2006; Yeh et al., 2014). Some studies have addressed the peak values of the joint angles and joint moments of the lower extremities in the medial-lateral (M/L) and anterior-posterior (A/P) direction during stance phase (Butler et al., 2009; Kakihana et al., 2007), and others have focused on these variables when peak internal abductor moments occurred (Hsu et al., 2015; Yeh et al., 2014). Several studies have also addressed the mechanism of frontal ground reaction force (GRF) and lever arm relative to the joints of the lower extremities (Hinman et al., 2012; Hsu et al., 2015; Yeh et al., 2014) and spatiotemporal parameters such as step length, step width, and walking speed (Hinman et al., 2008; Schmalz et al., 2006; Shimada et al., 2006). It has been reported that people with medial knee OA wearing laterally-wedged insoles with arch support (LWAS) immediately demonstrate decreased peak internal knee abductor moments due to the laterally-shifted COP; however, the M/L COM position remained unchanged (Yeh et al., 2014). A long-term follow-up study also found similar effects on M\L COP position (Hsu et al., 2015). These studies showed that the LWAS might have benefit in reducing knee joint loading as well as joint pain. However, the altered COP position might affect the dynamic stability of level walking and people would adopt different strategies during level walking. To our knowledge, there were no study investigate the effects of LWAS on dynamic stability during level walking in people with medial knee OA. Studies on this issue might be beneficial to give consideration to both the comfort on knee joint and the safety during locomotion for people with medial knee OA, and would be helpful for clinical application of the LWAS to people with medial knee OA.

Therefore, the present study aimed to investigate the effects of LWAS on the motion of the body COM in terms of IA and RCIA during level walking. It was hypothesized that the demand for maintaining dynamic stability would increase due to larger IA, and people with medial knee OA would demonstrate different strategies, such as the RCIA with opposite direction, to maintain dynamic stability immediately upon wearing LWAS.

# 2. Methods

## *2.1 Participants*

Fifteen women diagnosed with bilateral medial knee OA (the OA group; age: 66.80 ± 5.45 years old; body height: 1.53 ± 0.04 m; body mass: 57.40 ± 6.32 kg) were recruited by a physician. The inclusion criteria for people with medial knee OA were: (1) bilateral medial knee OA, (2) grade 2 or 3 for both knees according to Kellgren/Lawrence grading (Kellgren & Lawrence, 1957), and (3) ability to walk without assistive devices. Participants were excluded if they (1) had received treatment including foot orthoses, intra-joint injections, or an operation in the past 6 months; or (2) had other neuromusculoskeletal disorders, visual impairment, or cognitive dysfunction that might cause gait problems. Age- and gender-matched healthy control (HC) group (age: 65.27 ± 4.04 years old; body height: 1.54 ± 0.05 m; body mass: 57.40 ± 7.53 kg) with normal or corrected-to-normal vision and no neuromusculoskeletal pathology were recruited. The purposes of recruiting HC group were to ensure whether the findings belonged to OA group by statistical analysis. The present study was approved by the Institutional Human Research Ethics Committee. Written informed consent was obtained from participants prior to the experiments.

## *2.2 Laterally-wedged insoles with arch support*

Participants underwent gait analysis in kung fu shoes with a flat insole (FLAT) and the LWAS bilaterally (Fig. 1). Kung fu shoes are the shoes that middle-aged and older adults commonly wear in Taiwan. For the FLAT condition, participants wore kung fu shoes with the original flat insoles inside. For the LWAS condition, the flat insoles were replaced with custom-made insoles consisting of a lateral wedge extending along the entire length of the foot with arch support placed medially. The LWAS were made by an occupational therapist and composed of ethylene vinyl acetate with a 7° lateral inclination. Individual footprints and the height of the navicular tuberosity were used to determine the location of the arch support under the foot and its height.


**Figure 1**

Laterally-wedged insole with arch support from (A) medial and (B) lateral views.

## *2.3 Data collection*

Each participant was asked to walk on an 8-meter walkway at a self-selected pace in the FLAT and LWAS conditions in random order, determined by a random number table. The participants were allowed several practice trials to ensure that they could walk comfortably along the walkway while wearing markers and the LWAS. Six successful trials, defined as trials during which the subject did not step outside the forceplates, were recorded for each condition. Infrared retroreflective markers were attached on the following locations: the C7-T1 junction as well as the left and right sides of the body on the ear canal, acromion processes, lateral and medial humeral epicondyles, ulna styloids, anterior superior iliac spines, posterior superior iliac spines, greater trochanters, mid-thighs, lateral and medial femoral epicondyles, tibial tuberosities, fibular heads, lateral and medial malleoli, heels, navicular tuberosities, and fifth metatarsal bases (Wang, Chen, Hsu, Liu, & Lu, 2010). While the shoes were worn, small holes were made in the shoes to place markers directly on the navicular tuberosities and fifth metatarsal bases. A

6-camera motion analysis system (Vicon MX13+ camera system, Oxford Metrics Ltd, Oxford, UK) with a sampling rate of 120 Hz and 2 forceplates (OR-6-7-1000, Advanced Mechanical Technology Inc., Watertown, MA, USA) with a sampling rate of 1,080 Hz were used to capture three-dimensional marker trajectories and GRF, respectively.

## *2.4 Data analysis*

For dynamic analysis, the body was modeled as a 12-link system, including trunk-head-neck, upper arms, forearm-hands, pelvis, thighs, shanks, and feet (Lu, Chien, & Chen, 2007). According to the convention recommended by the International Society of Biomechanics (Wu & Cavanagh, 1995), each link was embedded with an orthogonal coordinate system having the positive x axis directed anteriorly, the positive y axis directed superiorly, and the positive z axis to the right. The rotational movements of each joint were described by a Cardanic rotation sequence (z-x-y) (Cole, Nigg, Ronsky, & Yeadon, 1993). Intersegmental forces and internal moments at the joints of the lower limbs were calculated using inverse dynamics with the measured GRF and kinematic data (Chen, Lu, Wang, & Huang, 2008). Inertial properties for each body segment, namely mass, COM, and moment of inertia, were obtained using Dempster’s coefficients (Dempster, Gabel, & Felts, 1959). The body’s COM position was calculated as the weighted sum of all the body segments, including head and neck, trunk, pelvis, arms, forearms, thighs, shanks, and feet. The COP positions were calculated using forces and moments measured by the forceplates (Hsieh, Lu, Chen, Chang, & Hung, 2011). The M/L positions of the COM and COP were described relative to the line of progression that bisected the M/L range of motion of the body COM during a gait cycle, a positive value being to the side of the contralateral limb (Huang, Lu, et al., 2008). The A/P positions of the COM and COP were described relative to the position of heel-strike, a positive value being anterior to that position (Chien et al., 2014). During the double-stance phase, a resultant COP was calculated for both feet using the COP and vertical ground reaction force from each foot (Jian, Winter, Ishac, & Gilchrist, 1993). The method described by Lee and Chou was used to obtain M/L and A/P IA, representing the distance between the COM and COP (Lee & Chou, 2006). The M/L and A/P RCIA, indicating the velocity of the COM relative to the COP, were also calculated by smoothing and differentiating the trajectories of M/L and A/P IA by the generalized cross-validatory spline method (Woltring, 1986).

### *2.5 Biomechanical indices*

The M/L as well as A/P IA and RCIA at the following instances were extracted: toe-off of the contralateral leg (T1), occurrences of the first and second peak internal knee abductor moments (T2 and T3), heel-strike of the contralateral leg (T4), toe-off of the ipsilateral leg (T5), and heel-strike of the ipsilateral leg (T6). The step length and step width were defined as the horizontal and lateral distances between the heel markers on both limbs when the heel contacted the forceplate, respectively. The duration of stance phase was defined as the percentage of stance phase in gait cycle. The gait speed was also calculated.

### 2.6 Statistical analysis

A 2 (group) × 2 (condition) mixed-model analyses of variance was used to evaluate the effects of insole and group on biomechanical indices ($\alpha$=.05). A pairwise comparison was used when an interaction was found; otherwise, the main effects were reported. All statistical analyses were performed using SPSS (version 17).

## 3. Results

Only main effects of group and/or insole are reported because no interactions between group and insole were found for any biomechanical indices.

### 3.1 Spatiotemporal parameters

The spatiotemporal parameters are shown in Table 1. There was no main effect of insole for any of the spatiotemporal parameters. The main effects of group were found only in gait speed. The walking speed of the OA group ($p_g$ = 0.01) was slower than that of the HC group.

### 3.2 The M/L IA and RCIA

The ensemble-averaged curve of M/L IA and RCIA shown in Figure 2(A) and Figure 2(B). Their values at critical time points are shown in Table 2. There was no main effect of group or insole for M/L RCIA. The OA group had smaller M/L IA at the occurrences of the second peak internal knee abductor moment (T3; $p_g$ = 0.03). While wearing LWAS, both groups demonstrated larger M/L IA at the occurrences of the first and second peak internal knee abductor moments, heel-strike of the contralateral leg, and heel-strike of the ipsilateral leg (T2, T3, T4, and T6; $p_i < 0.05$).

**Table 1**

Means and standard deviations of spatiotemporal parameters

| | | FLAT | LWAS | Effects | |
|---|---|---|---|---|---|
| Stance phase (%) | OA | 61.78 ± 1.22 | 61.82 ± 1.83 | $F_g$=0.04 | $p_g$=0.84 |
| | HC | 61.40 ± 1.63 | 62.49 ± 1.80 | $F_i$=4.09 | $p_i$=0.06 |
| Speed (m/s) | OA | 0.84 ± 0.12 | 0.85 ± 0.12 | $F_g$=7.96 | $p_g$=0.01* |
| | HC | 0.98 ± 0.06 | 0.96 ± 0.08 | $F_i$=0.19 | $p_i$=0.67 |
| Step length (%LL) | OA | 61.20 ± 4.83 | 61.70 ± 5.70 | $F_g$=0.32 | $p_g$=0.77 |
| | HC | 62.18 ± 3.98 | 62.02 ± 3.70 | $F_i$=0.09 | $p_i$=0.58 |
| Step width (%LL) | OA | 11.73 ± 4.08 | 11.84 ± 4.10 | $F_g$=0.003 | $p_g$=0.89 |
| | HC | 11.58 ± 2.78 | 11.51 ± 3.46 | $F_i$=0.02 | $p_i$=0.96 |

NOTE. Values are mean ± SD unless indicated otherwise.

Abbreviations: $F_g$ and $p_g$, $F$-value and $p$-value of group effect; $F_i$ and $p_i$, $F$-value and $p$-value of insole effect;*: $p_g$ <.05.

### *3.3 The A/P IA and RCIA*

The ensemble-averaged curve of A/P IA and RCIA shown in Figure 2(C) and Figure 2(D). Their values at critical time points are shown in Table 3. There was no main effect of group in A/P IA or RCIA. While wearing LWAS, both groups demonstrated smaller A/P IA at heel-strike of the contralateral leg (T4; $p_i = 0.02$) and smaller A/P RCIA at toe-off of the ipsilateral leg (T5; $p_i = 0.004$) and heel-strike of the ipsilateral leg (T6; $p_i = 0.003$).

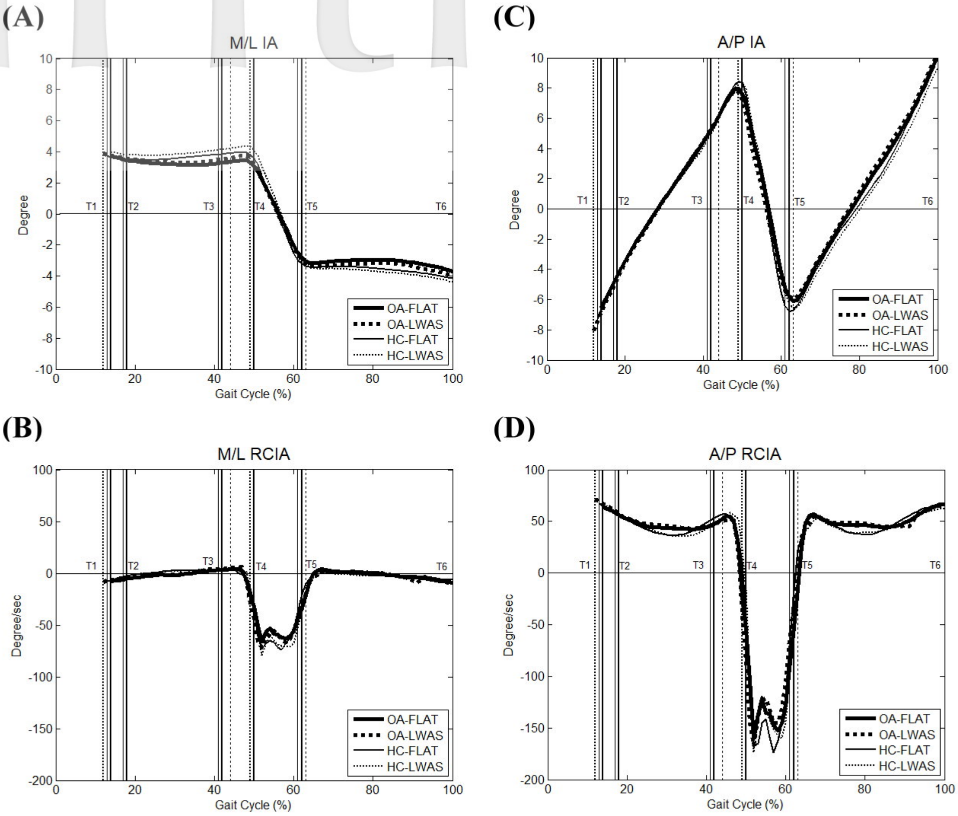


**Figure 2**

Ensemble-averaged curve of (A) M/L IA, (B) M/L RCIA, (C) A/P IA, and (D) A/P RCIA for both groups and insoles. Abbreviations: M/L, medial/lateral; IA, COM-COP inclination angles; RCIA, the rate of change of IA; A/P, anterior/posterior; T1, toe-off of the contralateral leg; T2, occurrence of first peak knee internal abductor moment; T3, occurrence of second peak knee internal abductor moment; T4, heel-strike of the contralateral leg; T5, toe-off of the ipsilateral leg; T6, heel-strike of the ipsilateral leg.

**Table 2**

Means and standard deviations of M/L IA and RCIA at critical instance

| | | | FLAT | LWAS | Effects | |
|---|---|---|---|---|---|---|
| IA | T1 | OA | 4.15 ± 0.78 | 4.15 ± 0.93 | $F_g$=0.06 | $p_g$=0.81 |
| | | HC | 4.09 ± 0.85 | 4.42 ± 0.99 | $F_i$=1.94 | $p_i$=0.18 |
| | T2 | OA | 3.28 ± 0.56 | 3.50 ± 0.50 | $F_g$=0.31 | $p_g$=0.58 |
| | | HC | 3.46 ± 0.63 | 3.63 ± 0.77 | $F_i$=6.24 | $p_i$=0.02** |
| | T3 | OA | 3.06 ± 0.64 | 3.30 ± 0.70 | $F_g$=5.03 | $p_g$=0.03* |
| | | HC | 3.75 ± 0.61 | 4.00 ± 0.83 | $F_i$=4.71 | $p_i$=0.04** |
| | T4 | OA | 3.60 ± 0.74 | 3.94 ± 0.81 | $F_g$=1.89 | $p_g$=0.19 |
| | | HC | 4.14 ± 0.84 | 4.44 ± 0.92 | $F_i$=8.97 | $p_i$=0.009** |
| | T5 | OA | -2.51 ± 0.81 | -2.64 ± 0.95 | $F_g$=0.34 | $p_g$=0.57 |
| | | HC | -2.74 ± 0.62 | -2.83 ± 0.74 | $F_i$=1.67 | $p_i$=0.22 |
| | T6 | OA | -3.69 ± 0.78 | -3.98 ± 1.09 | $F_g$=1.26 | $p_g$=0.28 |
| | | HC | -4.16 ± 0.72 | -4.39 ± 0.81 | $F_i$=6.66 | $p_i$=0.02** |
| RCIA | T1 | OA | -10.46 ± 6.75 | -8.92 ± 8.97 | $F_g$=2.40 | $p_g$=0.14 |
| | | HC | -5.27 ± 6.43 | -4.62 ± 5.02 | $F_i$=0.90 | $p_i$=0.36 |
| | T2 | OA | -16.61 ± 77.77 | 33.50 ± 122.27 | $F_g$=0.33 | $p_g$=0.57 |
| | | HC | 74.10 ± 133.83 | -17.15 ± 22.94 | $F_i$=0.49 | $p_i$=0.50 |
| | T3 | OA | -3.65 ± 2.08 | -2.76 ± 2.63 | $F_g$=1.79 | $p_g$=0.20 |
| | | HC | -2.15 ± 4.67 | -0.51 ± 2.95 | $F_i$=4.49 | $p_i$=0.05 |
| | T4 | OA | -20.53 ± 18.65 | -18.14 ± 14.47 | $F_g$=2.86 | $p_g$=0.11 |
| | | HC | -30.74 ± 23.69 | -35.96 ± 24.44 | $F_i$=0.08 | $p_i$=0.79 |
| | T5 | OA | -45.52 ± 15.91 | -46.86 ± 12.77 | $F_g$=0.79 | $p_g$=0.79 |
| | | HC | -50.32 ± 18.72 | -38.15 ± 17.15 | $F_i$=3.23 | $p_i$=0.09 |
| | T6 | OA | -9.16 ± 4.66 | -9.34 ± 4.71 | $F_g$=2.23 | $p_g$=0.16 |
| | | HC | 6.10 ± 2.87 | -7.37 ± 3.07 | $F_i$=0.92 | $p_i$=0.35 |

NOTE. Values are mean ± SD unless indicated otherwise.

Abbreviations: M/L, medial/lateral; IA, COM-COP inclination angles; RCIA, the rate of change of IA; T1, toe-off of the contralateral leg; T2, occurrence of first peak knee internal abductor moment; T3, occurrence of second peak knee internal abductor moment; T4, heel-strike of the contralateral leg; T5, toe-off of the ipsilateral leg; T6, heel-strike of the ipsilateral leg; $F_g$ and $p_g$, *F*-value and *p*-value of group effect; $F_i$ and $p_i$, *F*-value and *p*-value of insole effect;*: $p_g$ <.05; **: $p_i$ <.05.

**Table 3**

Means and standard deviations of A/P IA and RCIA at critical instance

| | | | FLAT | LWAS | Effects | |
|---|---|---|---|---|---|---|
| IA (°) | T1 | OA | -9.58 ± 1.04 | -10.12 ± 1.48 | $F_g$=1.04 | $p_g$=0.32 |
| | | HC | -10.47 ± 0.88 | -10.30 ± 1.20 | $F_i$=1.41 | $p_i$=0.25 |
| | T2 | OA | -4.51 ± 1.64 | -4.43 ± 1.75 | $F_g$=0.06 | $p_g$=0.80 |
| | | HC | -5.01 ± 1.56 | -4.25 ± 0.72 | $F_i$=2.37 | $p_i$=0.14 |
| | T3 | OA | 4.93 ± 1.85 | 5.26 ± 1.12 | $F_g$=0.002 | $p_g$=0.97 |
| | | HC | 4.75 ± 2.62 | 5.50 ± 1.70 | $F_i$=3.49 | $p_i$=0.08 |
| | T4 | OA | 9.11 ± 0.46 | 8.93 ± 0.48 | $F_g$=2.41 | $p_g$=0.14 |
| | | HC | 9.72 ± 0.79 | 9.19 ± 0.84 | $F_i$=6.59 | $p_i$=0.02* |
| | T5 | OA | -5.64 ± 0.69 | -5.65 ± 0.70 | $F_g$=2.90 | $p_g$=0.10 |
| | | HC | -6.35 ± 1.19 | -6.34 ± 1.00 | $F_i$>0.001 | $p_i$=0.99 |
| | T6 | OA | 10.07 ± 0.95 | 10.30 ± 1.05 | $F_g$=0.54 | $p_g$=0.47 |
| | | HC | 10.13 ± 1.67 | 9.36 ± 1.71 | $F_i$=1.00 | $p_i$=0.33 |
| RCIA (°/sec) | T1 | OA | 57.63 ± 23.17 | 60.62 ± 13.36 | $F_g$=1.51 | $p_g$=0.24 |
| | | HC | 54.12 ± 14.10 | 47.81 ± 10.19 | $F_i$=0.23 | $p_i$=0.64 |
| | T2 | OA | 404.14 ± 476.76 | 365.53 ± 387.98 | $F_g$=1.87 | $p_g$=0.19 |
| | | HC | 263.34 ± 359.38 | 100.69 ± 161.80 | $F_i$=1.33 | $p_i$=0.27 |
| | T3 | OA | 41.64 ± 6.79 | 40.97 ± 5.08 | $F_g$=0.001 | $p_g$=0.98 |
| | | HC | 42.87 ± 15.40 | 40.01 ± 11.35 | $F_i$=1.46 | $p_i$=0.25 |
| | T4 | OA | -15.48 ± 51.25 | -5.85 ± 25.29 | $F_g$=2.84 | $p_g$=0.11 |
| | | HC | -50.80 ± 58.56 | -32.93 ± 56.95 | $F_i$=0.90 | $p_i$=0.36 |
| | T5 | OA | -92.11 ± 61.94 | -81.43 ± 63.46 | $F_g$=0.07 | $p_g$=0.79 |
| | | HC | -106.85 ± 54.41 | -53.78 ± 34.78 | $F_i$=11.26 | $p_i$=0.004* |
| | T6 | OA | 66.73 ± 7.45 | 64.98 ± 6.42 | $F_g$=0.47 | $p_g$=0.51 |
| | | HC | 65.12 ± 6.39 | 62.25 ± 7.23 | $F_i$=12.41 | $p_i$=0.003* |

NOTE. Values are mean ± SD unless indicated otherwise.

Abbreviations: A/P, anterior/posterior; IA, COM-COP inclination angles; RCIA, the rate of change of IA; T1, toe-off of the contralateral leg; T2, occurrence of first peak knee internal abductor moment; T3, occurrence of second peak knee internal abductor moment; T4, heel-strike of the contralateral leg; T5, toe-off of the ipsilateral leg; T6, heel-strike of the ipsilateral leg; $F_g$ and $p_g$, $F$-value and $p$-value of group effect; $F_i$ and $p_i$, $F$-value and $p$-value of insole effect;*: $p_i$ <.05.

# 4. Discussion

The aims of the present study were to investigate the dynamic stability of people with medial knee OA while wearing LWAS during level walking. Walking at a self-selected gait speed, the people with medial knee OA generally showed similar gait patterns, such as similar step length, step width, and duration of stance phase, that were similar to those of the healthy control group. While wearing LWAS, the people with medial knee OA demonstrated a increased demand for dynamic control in the M/L direction. However, such demand decreased in the A/P direction with unchanged gait speed.

The contralateral leg toe-off (T1) indicated the end of double leg stance (DLS) and the beginning of single leg stance (SLS). At this instance, the unchanged IA and RCIA in the A/P and M/L direction indicated that, while wearing LWAS, people with medial knee OA adopted strategies similar to those of the HC group during the transition from DLS to SLS. However, the changes appeared when the first and second peak internal knee abductor moments occurred (T2 and T3), the two moments at which maximal joint loading was needed for balance control during SLS, as well as at heel-strike of the contralateral leg and the ipsilateral leg (T4 and T6), the time points of transition from SLS to DLS. During these two periods, people with medial knee OA had greater IA with unchanged RCIA in the M/L direction while wearing LWAS. Previous studies have suggested that maintaining balance depends on the positions of COM and the magnitude and direction of COM velocity with respect to the base of support (Pai, Naughton, Chang, & Rogers, 1994; Pai & Patton, 1997). For this reason, the greater M/L IA has been seen as a sign of instability (Chou et al., 2003; Lee & Chou, 2006). Previous studies showed that the LWAS had positive effects in reducing the internal knee abductor moments and joint pain (Hsu et al., 2015; Yeh et al., 2014); however, the increased M/L IA found in the present study, indicating that the LWAS seemed to induce instability in the M/L direction and increase demands on dynamic control.

Some studies that addressed dynamic control during locomotion have suggested that smaller M/L IA were the strategies that people would adopt when facing imbalance; whereas, when greater M/L IA appeared, greater M/L RCIA with opposite direction was required to prevent falls (Chien et al., 2014; Hong et al., 2015; Hsu et al., 2010). Once away from the base of support, the COM with faster velocity in the opposite direction were used for keeping an appropriate distance between the COM and the base of support; otherwise, falls may occur during locomotion. Furthermore, the increased M/L IA may also be accompanied by an increased step width during the transition from SLS to DLS. This is one way to enlarge the base of support and thereby to prevent falls (Chien et al., 2014). However, the step width and M/L RCIA in the present study was unchanged when LWAS were worn. The M/L RCIA and step width may have remained unchanged due to the amount of challenge in the task. The task in the present study was level walking with LWAS worn in regular shoes, which may be easier than crossing an obstacle or wearing narrow-heeled shoes (Chien et al., 2013, 2014; Hsu et al., 2010). Yeh et al. reported that the LWAS would not change the M/L COM position but make the COP lateral-shifted to reduce internal knee abductor moments in people with medial knee OA (Yeh et al., 2014). These finding indicated that the increased M/L IA were induced by the lateral-shifted COP. Thus, although the M/L IA increased, level walking, a relatively easier task, enabled the people with medial knee OA to maintain COM trajectory in the M/L direction without increasing their M/L RCIA and step width. The unchanged duration of stance phase and step length found in the present study also support this explanation. The challenge of increased M/L IA with unchanged RCIA and step width while wearing LWAS during level walking seemed not to cause instability in people with medial OA; thus, they were stable enough to complete the swing phase. However, when facing a more challenging task, including obstacle crossing and uphill walking, people with knee OA may require different control strategies to maintain dynamic stability in the M/L direction. It may be necessary to design training in M/L balance control for people with medial knee OA when applying LWAS.

Although the increased M/L IA while wearing LWAS during level walking seemed not to affect balance control more in the M/L direction, several effects of LWAS on the dynamic stability in the A/P direction could be found. At heel-strike of the contralateral leg (T4), people with medial knee OA tended to reduce their A/P IA. Shortening the distance between the COM and the COP has been suggested as a conservative control strategy for dynamic stability (Huang, Lu, et al., 2008). It might be helpful for people with medial knee OA to maintain sufficient A/P stability with minimal effort under the greater M/L sway of the COM with respect to the COP. The smaller A/P RCIA with unchanged IA found at toe-off and heel-strike of the ipsilateral leg indicated that a different strategy was adopted by the people with medial knee OA while wearing LWAS. At toe-off of the ipsilateral leg, when the COM was located posterior to the COP, the smaller negative RCIA in the A/P direction indicated that the COM moved posteriorly with a slower velocity. The slower velocity directed posteriorly may prevent the COM from moving posteriorly too fast and thus keep the COM forward. This strategy could be helpful in further propulsion after toe-off. The smaller negative RCIA in the A/P direction at heel-strike of the ipsilateral leg may also be beneficial to postural control. At this instance, when the COM is located anteriorly to the COP, the slower forward velocity might prevent the COM from moving outside the base of support, thereby preventing falls.

# 5. Conclusion

The immediate effects of the LWAS on level walking were investigated in people with medial knee OA. In the A/P direction, shortening the distance between the COM and the COP at heel-strike of the contralateral leg and reducing the velocity of the COM at toe-off and heel-strike may help to maintain balance and prevent the COM from moving outside the base of support. In the M/L direction, increased IA during translation between SLS and DLS indicated an increased demand on postural control. However, the people with medial knee OA could still manage this challenge during level walking with unchanged RCIA. It suggested that the balance training program for M/L dynamic stability were required for users. Furthermore, the effects of the LWAS on other types of locomotion, such as obstacle crossing and uphill walking, should be also addressed in future studies.

## References

Berger, W., Trippel, M., Discher, M., & Dietz, V. (1992). Influence of Subjects' Height on the Stabilization of Posture. *Acta Oto-Laryngologica, 112*(1), 22-30.

Butler, R. J., Barrios, J. A., Royer, T., & Davis, I. S. (2009). Effect of Laterally Wedged Foot Orthoses on Rearfoot and Hip Mechanics in Patients with Medial Knee Osteoarthritis. *Prosthetics and Orthotics International, 33*(2), 107-116.

Chen, H. L., Lu, T. W., Wang, T. M., & Huang, S. C. (2008). Biomechanical strategies for successful obstacle crossing with the trailing limb in older adults with medial compartment knee osteoarthritis. *Journal of Biomechanics, 41*(4), 753-761.

Chien, H. L., Lu, T. W., & Liu, M. W. (2013). Control of the motion of the body's center of mass in relation to the center of pressure during high-heeled gait. *Gait & Posture, 38*(3), 391-396.

Chien, H. L., Lu, T. W., & Liu, M. W. (2014). Effects of long-term wearing of high-heeled shoes on the control of the body's center of mass motion in relation to the center of pressure during walking. *Gait & Posture, 39*(4), 1045-1050.

Chou, L. S., Kaufman, K. R., Brey, R. H., & Draganich, L. F. (2001). Motion of the whole body's center of mass when stepping over obstacles of different heights. *Gait & Posture, 13*(1), 17-26.

Chou, L. S., Kaufman, K. R., Hahn, M. E., & Brey, R. H. (2003). Medio-lateral motion of the center of mass during obstacle crossing distinguishes elderly individuals with imbalance. *Gait & Posture, 18*(3), 125-133.

Cole, G. K., Nigg, B. M., Ronsky, J. L., & Yeadon, M. R. (1993). Application of the Joint Coordinate System to Three-Dimensional Joint Attitude and Movement Representation: A Standardization Proposal. *Journal of Biomechanical Engineering, 115*(4A), 344-349.

Dempster, W. T., Gabel, W. C., & Felts, W. J. L. (1959). The anthropometry of the manual work space for the seated subject. *American Journal of Physical Anthropology, 17*(4), 289-317.

Gök, H., Ergin, S., & Yavuzer, G. (2002). Kinetic and kinematic characteristics of gait in patients with medial knee arthrosis. *Acta Orthopaedica Scandinavica, 73*(6), 647-652.

Hinman, R. S., Bowles, K. A., Metcalf, B. B., Wrigley, T. V., & Bennell, K. L. (2012). Lateral wedge insoles for medial knee osteoarthritis: effects on lower limb frontal plane biomechanics. *Clinical Biomechanics, 27*(1), 27-33.

Hinman, R. S., Bowles, K. A., Payne, C., & Bennell, K. L. (2008). Effect of length on laterally-wedged insoles in knee osteoarthritis. *Arthritis Care & Research, 59*(1), 144-147.

Hong, S. W., Leu, T. H., Wang, T. M., Li, J. D., Ho, W. P., & Lu, T. W. (2015). Control of body's center of mass motion relative to center of pressure during uphill walking in the elderly. *Gait & Posture, 42*(4), 523-528.

Hoyert, D. L., Arias, E., Smith, B. L., Murphy, S. L., & Kochanek, K. D. (2001). Deaths: final data for 1999. *National Vital Statistics Report, 49*(8), 1-113.

Hsieh, H.-J., Lu, T.-W., Chen, S.-C., Chang, C.-M., & Hung, C. (2011). A new device for in situ static and dynamic calibration of force platforms. *Gait & Posture, 33*(4), 701-705.

Hsu, W. C., Jhong, Y. C., Chen, H. L., Lin, Y. J., Chen, L. F., & Hsieh, L. F. (2015). Immediate and long-term efficacy of laterally-wedged insoles on persons with bilateral medial knee osteoarthritis during walking. *Biomedical Engineering Online, 14*, 43-43.

Hsu, W. C., Wang, T. M., Liu, M. W., Chang, C. F., Chen, H. L., & Lu, T. W. (2010). Control of body's center of mass motion during level walking and obstacle-crossing in older patients with knee osteoarthritis. *Journal of Mechanics, 26*(2), 229-237.

Huang, S. C., Lu, T. W., Chen, H. L., Wang, T. M., & Chou, L. S. (2008). Age and height effects on the center of mass and center of pressure inclination angles during obstacle-crossing. *Medical Engineering & Physics, 30*(8), 968-975.

Huang, S. C., Wei, I. P., Chien, H. L., Wang, T. M., Liu, Y. H., Chen, H. L., . . . Lin, J. G. (2008). Effects of severity of degeneration on gait patterns in patients with medial knee osteoarthritis. *Medical Engineering & Physics, 30*(8), 997-1003.

Hurwitz, D. E., Ryals, A. B., Case, J. P., Block, J. A., & Andriacchi, T. P. (2002). The knee adduction moment during gait in subjects with knee osteoarthritis is more closely correlated with static alignment than radiographic disease severity, toe out angle and pain. *Journal of Orthopaedic Research, 20*(1), 101-107.

Jian, Y., Winter, D. A., Ishac, M. G., & Gilchrist, L. (1993). Trajectory of the body COG and COP during initiation and termination of gait. *Gait & Posture, 1*(1), 9-22.

Kakihana, W., Akai, M., Nakazawa, K., Naito, K., & Torii, S. (2007). Inconsistent Knee Varus Moment Reduction Caused by a Lateral Wedge in Knee Osteoarthritis. *American Journal of Physical Medicine & Rehabilitation, 86*(6), 446-454.

Kellgren, J. H., & Lawrence, J. S. (1957). Radiological Assessment of Osteo-Arthrosis. *Annals of the Rheumatic Diseases, 16*(4), 494-502.

Lee, H. J., & Chou, L. S. (2006). Detection of gait instability using the center of mass and center of pressure inclination angles. *Archives Of Physical Medicine And Rehabilitation, 87*(4), 569-575.

Leveille, S. G., Bean, J., Bandeen-Roche, K., Jones, R., Hochberg, M., & Guralnik, J. M. (2002). Musculoskeletal Pain and Risk for Falls in Older Disabled Women Living in the Community. *Journal of the American Geriatrics Society, 50*(4), 671-678.

Lu, T. W., Chien, H. L., & Chen, H. L. (2007). Joint Loading in the Lower Extremities during Elliptical Exercise. *Medicine and Science in Sports and Exercise 39*(9), 1651-1658.

Mündermann, A., Dyrby, C. O., & Andriacchi, T. P. (2005). Secondary gait changes in patients with medial compartment knee osteoarthritis: Increased load at the ankle, knee, and hip during walking. *Arthritis & Rheumatism, 52*(9), 2835-2844.

Mündermann, A., Dyrby, C. O., Hurwitz, D. E., Sharma, L., & Andriacchi, T. P. (2004). Potential strategies to reduce medial compartment loading in patients with knee osteoarthritis of varying severity: Reduced walking speed. *Arthritis & Rheumatism, 50*(4), 1172-1178.

Miyazaki, T., Wada, M., Kawahara, H., Sato, M., Baba, H., & Shimada, S. (2002).

Dynamic load at baseline can predict radiographic disease progression in medial compartment knee osteoarthritis. *Annals of the Rheumatic Diseases, 61*(7), 617-622.

Pai, Y.-C., Naughton, B. J., Chang, R. W., & Rogers, M. W. (1994). Control of body centre of mass momentum during sit-to-stand among young and elderly adults. *Gait & Posture, 2*(2), 109-116.

Pai, Y.-C., & Patton, J. (1997). Center of mass velocity-position predictions for balance control. *Journal of Biomechanics, 30*(4), 347-354.

Schmalz, T., Blumentritt, S., Drewitz, H., & Freslier, M. (2006). The influence of sole wedges on frontal plane knee kinetics, in isolation and in combination with representative rigid and semi-rigid ankle-foot-orthoses. *Clinical Biomechanics, 21*(6), 631-639.

Shimada, S., Kobayashi, S., Wada, M., Uchida, K., Sasaki, S., Kawahara, H., . . . Kubota, M. (2006). Effects of disease severity on response to lateral wedged shoe insole for medial compartment knee osteoarthritis. *Archives Of Physical Medicine And Rehabilitation, 87*(11), 1436-1441.

Wang, T. M., Chen, H. L., Hsu, W. C., Liu, M. W., & Lu, T. W. (2010). Biomechanical Role of the Locomotor System in Controlling Body Center of Mass Motion in Older Adults During Obstructed Gait. *Journal of Mechanics, 26*(02), 195-203.

Woltring, H. J. (1986). A Fortran package for generalized, cross-validatory spline smoothing and differentiation. *Advances in Engineering Software (1978), 8*(2), 104-113.

Wu, G., & Cavanagh, P. R. (1995). ISB recommendations for standardization in the reporting of kinematic data. *Journal of Biomechanics, 28*(10), 1257-1261.

Yeh, H. C., Chen, L. F., Hsu, W. C., Lu, T. W., Hsieh, L. F., & Chen, H. L. (2014). Immediate efficacy of laterally wedged insoles with arch support on walking in persons with bilateral medial knee osteoarthritis. *Archives Of Physical Medicine And Rehabilitation, 95*(12), 2420-2427.

Yildiz, N., Topuz, O., Gungen, G. O., Deniz, S., Alkan, H., & Ardic, F. (2010). Health-related quality of life (Nottingham Health Profile) in knee osteoarthritis: correlation with clinical variables and self-reported disability. *Rheumatology international, 30*(12), 1595-1600.

Zhao, D., Banks, S. A., Mitchell, K. H., D'Lima, D. D., Colwell, C. W., & Fregly, B. J. (2007). Correlation between the knee adduction torque and medial contact force for a variety of gait patterns. *Journal of Orthopaedic Research, 25*(6), 789-797.

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原著

# 外側楔形鞋墊搭配足弓墊對內側退化性膝關節炎個案行走時動態穩定的立即效果

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## 摘要

**目的：**本研究旨在探討雙側內側退化性膝關節炎個案行走時穿戴外側楔形鞋墊搭配足弓墊對於動態平衡的立即效果。

**方法：**本研究納入 15 名被診斷為雙側內側退化性膝關節炎女性以及 15 名對照組女性。使用高速紅外線攝影機與測力板紀錄受試者穿戴鞋墊行走時的運動學資料與地面反作用力。以代表身體質量中心與壓力中心間相對距離以及速度之傾角與傾角變化率量測動態穩定的變化。

**結果：**穿戴外側楔形鞋墊搭配足弓墊後，前後方向的傾角與傾角變化率變小，側向方向的傾角則變大。

**結論：**雙側內側退化性膝關節炎個案穿戴外側楔形鞋墊搭配足弓墊有利於行走時前後動態穩定，但會增加維持側向動態穩定的需求。因此，建議外側楔形鞋墊搭配足弓墊的使用者應接受平衡訓練，且未來的研究應探討外側楔形鞋墊搭配足弓墊對於其他難度高於行走之移行活動的影響，例如：跨越障礙物、上坡行走。

**關鍵字：**動態穩定，退化性膝關節炎，外側楔形鞋墊

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原著

# 降低電腦化數字警醒測驗應用於中風患者之隨機測量誤差：初步研究

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## 摘要

電腦化數字警醒度測驗 (Computerized Digit Vigilance Test, C-DVT) 可迅速且有效地評估個案之持續性注意力，具臨床常態使用之潛力。然而，C-DVT 之隨機測量誤差仍大，尚待改良。本研究目的為比較二種施測 C-DVT 方式（「增加練習時間」與「二次施測取平均」）之隨機測量誤差是否低於原施測方式，以探索有效降低隨機測量誤差的方法。同時，我們檢驗上述二種施測方式對 C-DVT 再測信度與練習效應的影響。共 16 位中風病患參與本研究，個案以隨機分配到增加練習時間組或二次施測取平均組（每組 8 人）。我們另抽取二次施測取平均組（即個案於初、再測之第一次評估結果）的資料組成原始施測組。隨機測量誤差之結果（以最小可偵測差異值百分率 (percentage of minimal detectable change, MDC%)）顯示：增加練習時間 (19.4%) 與二次施測取平均 (21.4%) 都比原始施測組 (22.9%) 低。再測信度方面，二次施測取平均組的組內相關係數 (intraclass correlation coefficient = 0.74) 高於增加練習時間組 (0.69) 與原始施測組 (0.70)；練習效應部分則發現二次施測取平均組的效應值 (Cohen's $d$ = 0.34) 和增加練習時間組 (0.37) 都比原始施測組低 (0.39)。本研究結果顯示：正式施測 C-DVT 前增加 5 分鐘的練習，具潛力可降低較多隨機測量誤差。而二次施測取平均較有助於提升再測信度與降低練習效應。未來研究宜增加樣本數，以確認增加練習時間對降低隨機測量誤差的效果。

**關鍵字：**電腦化數字警醒度測驗，中風，隨機測量誤差

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# 前言

持續性注意力 (sustained attention) 是個體維持其注意力於特定任務達一段時間之能力 (Virk, Williams, Brunsdon, Suh, & Morrow, 2015)。持續性注意力之損傷是中風個案常見的問題：約半數以上 (46~92%) 的中風個案在發病初期即出現持續性注意力之損傷 (Hyndman, Pickering, & Ashburn, 2008)，影響個案的平衡與日常生活功能 (Hyndman & Ashburn, 2003)。同時，持續性注意力也是預測個案動作功能恢復之重要預測因子。為掌握與改善個案的持續性注意力問題，臨床人員需能精確評估中風個案的持續性注意力損傷，方能提供合適的治療計畫並追蹤治療成效。

電腦化數字警醒測驗 (Computerized Digit Vigilance Test, C-DVT) 可迅速且有效的評估個案的持續性注意力 (Yang, Lin, Chen, Hsueh, & Hsieh, 2015)。C-DVT 的優點有三：（1）對中風病患的可行性高：C-DVT 之題目的字體較大（36 號字），且操作簡單（僅需按下 O 或 X 的按鈕，且可用健側手完成），故有利於中風病患施測。（2）施測效能佳：C-DVT 之施測時間短（10 分鐘內），且可自動施測與計分，故能降低臨床人員與中風個案評估的負擔。同時，C-DVT 可及時提供評估結果，有利於臨床人員在評估後立即解釋結果並擬定介入目標。（3）心理計量特性良好：初步驗證的結果發現 C-DVT 具有良好的再測信度、同時效度與生態效度 (Yang et al., 2015)。以上優點顯示 C-DVT 可提供迅速且有效的持續性注意力評估，故具有臨床例行應用的潛力。

目前 C-DVT 的臨床應用問題在於隨機測量誤差 (random measurement error) 仍大，影響評估結果的可信度與偵測個案變化的能力。隨機測量誤差是於個案能力穩定不變的前提下，因隨機或偶然因素造成重複施測之觀察分數忽大或小，進而造成測量結果不穩定的狀況 (Portney & Watkins, 2009)。隨機測量誤差常以最小可偵測變化值百分比 (percentage of minimal detectable change, MDC%) 為指標，代表此測量誤差相對於樣本平均分數之百分比率。昔日研究顯示 C-DVT 應用於中風病患的 MDC%約占個案平均分數的 15% (Yang et al., 2015)。隨機測量誤差大，易造成評估工具難以偵測個案的功能改變或治療成效（如：難以區辨分數之改變是

誤差或真實變化所致），進而可能誤導療效判斷與臨床決策 (Beckstead, 2013)。若能降低 C-DVT 的 MDC%，則可提升 C-DVT 之實用價值。

現今臨床與研究中常用以降低隨機測量誤差的方法有二：（1）多次施測取平均：多次施測正式測驗後取其平均分數做為最終分數，平均值可抵銷因隨機測量誤差所造成的分數不穩定（或高或低）(Schreuders et al., 2003)；（2）增加練習時間：在正式施測前增加練習時間，以減少個案於測驗中的不穩定性（如：不熟悉操作方式），進而降低隨機測量誤差 (Lu, Huang, & Hsieh, 2009)。然而，上述二種施測方式對 C-DVT 隨機測量誤差的影響尚屬未知。本研究的目的為比較使用二種方式（多次施測取平均或增加練習時間）施測 C-DVT 的隨機測量誤差是否低於原始施測方式，以探索有效降低隨機測量誤差之方法。為提升此二方法的應用價值，我們亦比較二種施測方式對再測信度與練習效應的影響。

# 方法

## 一、樣本

本研究為前瞻性研究，樣本來自臺灣中部一間區域級教學醫院。個案之納入條件有三：（1）診斷為中風；（2）發病超過半年、症狀穩定；（3）視力與認知功能足以完成電腦與紙筆測驗者。如個案因視力不佳而難以完成電腦測驗，則予以排除。本研究經人體試驗委員會審查通過，且所有受試者均簽署紙本同意書。

## 二、程序

本研究之收案時間為 104 年 4 月至 105 年 3 月。參與本研究之個案共需接受二次評估（初、再評），間隔時間為二週。我們使用美國國衛院腦中風評估表 (National Institute of Health Stroke Scale, NIHSS) (Green, 2006)、簡式智力測驗 (Mini-Mental State Examination, MMSE) (Folstein, Folstein, & McHugh, 1975) 與巴氏量表 (Barthel index, BI) (Mahoney & Barthel, 1965)，以評量個案之特性（分別為中風嚴重度、認知能力以及日常生活功能）。

參與本研究之個案以隨機方式分配至：（1）增加練習時間組；或（2）二次施測取平均組。增加練習時間組的個案會在 C-DVT 正試測驗前額外接受 5 分鐘（相當於一次 C-DVT 正式施測所需時間）之練習，以降低操作 C-DVT 時間對二種施測方式降低隨機測量誤差之效果的影響，二次施測取平均組的個案則接受連續二次的正式 C-DVT 評估（即 1 次練習與 2 次正式施測）。為避免個案在連續測驗中失去專注度，二次施測取平均組的個案在完成第一次 C-DVT 後會有足夠的休息時間（至少 3 分鐘），以減少疲勞等因素造成之影響。

我們另擷取原始 C-DVT 的施測資料（即二次施測取平均組之個案於初、再評時第一次評估的結果）組成原始施測組，以比較二種施測方法是否優於原始施測方法。

個案之人口學資料取自個案病歷，包含：性別、年齡、患側、中風類型、教育程度與中風日期（發病時間）等。

## 三、評估工具

### （一）*C-DVT*

C-DVT 評量持續性注意力。C-DVT 之內容可分為練習（28 題）與正式測驗（120 題）二個部份。在練習部分，受試者會學習如何對 C-DVT 做正確反應：即判斷螢幕中所呈現的數列（每列含 5 個數字）是否包含「數字 6」，若是，則要按下「O」按鈕；若否，則按下「X」按鈕。在正式測驗中，包含與不包含數字 6 的數列會交替出現。受試者需保持警覺，以快速且正確的作答 C-DVT。C-DVT 以個案完成測驗所需要的總秒數為主要指標。施測所需的時間越長，則代表個案之持續性注意力越差 (Yang et al., 2015)。我們未將 C-DVT 之錯誤率納入主要的持續性注意力指標，原因有二：（1）個案答錯的機率極低，故該指標所能提供的資訊有限；（2）昔日研究指出此答錯率較適合做為判斷受試者能否理解 C-DVT 操作方法之指標 (Yang et al., 2015)，而非合適的持續性注意力指標。C-DVT 應用於中風病患具有良好的再測信度、同時效度及生態效度 (Yang et al., 2015)。

### （二）BI

BI 為國內常用之日常生活功能量表，共有 10 題（如：餵食、移位、個人衛生等）。BI 採 2~4 點量尺計分，計分方式依題目而異（如洗澡與個人衛生為 0-1 計分；位移和行走則為 0-1-2-3 計分）。BI 的總分介於 0~20 分，分數越高代表受試者的日常生活功能表現越好。BI 應用於中風病患具有良好的再測信度、施測者間信度、同時效度、預測效度與團體層級反應性 (Hsueh, Lee, & Hsieh, 2001; Hsueh, Lin, Jeng, & Hsieh, 2002)。

### （三）MMSE

MMSE 為臨床與研究被廣泛應用之認知功能篩檢量表。MMSE 共有 30 題，包含 11 個項目（定向感、短期記憶力、注意力、語言能力、口語及文字理解、及空間概念等）。MMSE 之滿分介於 0~30 分間，分數越高代表個案的認知功能越好。MMSE 應用於中風病患具有穩定的再測信度、良好的同時效度與收斂效度 (Agrell & Dehlin, 2000; Grace et al., 1995)。

### （四）NIHSS

NIHSS 為臨床與研究領域被受推崇的中風嚴重程度指標 (Green, 2006; Lyden et al., 2005)。其共有 13 題，包含 11 個向度（如：認知能力、語言能力以及感覺動作能力等）。NIHSS 以 3~5 點量尺計分，計分方式因題目而異（如：意識障礙採 0-1-2 計分；下肢運動採用 0-1-2-3-4 計分）。NIHSS 的滿分介於 0~42 分間，分數越低，代表個案之症狀嚴重程度越高。NIHSS 應用於中風病患具有穩定的再測一致性以及可接受之同時效度與因素效度。

## 四、資料分析

隨機測量誤差是以最小可偵測變化值 (minimal detectable change, MDC) 為指標。MDC 代表評估工具在重複施測時，於特定信心水準下隨機測量誤差可能造成分數波動之範圍。評估工具之 MDC 若數值越大，則代表評估工具之測量結果越不

穩定。MDC 可由評估工具之測量標準誤 (standard error of measurement, SEM) 推估而得，其計算換算公式為：$MDC = 1.96 \times SEM \times \sqrt{2}$（1.96 為在 95%信心水準下的標準分數）；而 SEM 則代表評估結果之不穩定程度（即隨機測量誤差），其可透過 ICC 與樣本標準差 (standard deviation, SD) 計算而得（計算公式為：$SEM = SD \times \sqrt{(1 - ICC)}$ (Haley & Fragala-Pinkham, 2006)。理想之 MDC%數值應低於目標族群之平均得分的 10% (Flansbjer, Holmback, Downham, Patten, & Lexell, 2005)。

再測信度以二因子隨機效應模式 (2-way random effect model) 之組內相關係數 (intraclass correlation coefficient, ICC) (Shrout & Fleiss, 1979)，驗證 C-DVT 三種施測方式之再測一致性。ICC ≥ 0.70 代表 C-DVT 具有可接受之再測一致性，可用於團體層級之評估（例如：研究中比實驗組與對照組之比較）；ICC ≥ 0.90 則代表 C-DVT 具良好的再測信度，可用於個別層級之評估（如：臨床上測量單一個案的持續性注意力測驗）(Aaronson et al., 2002)。

練習效應則使用效應值指標(Cohen's *d*)分析，代表三種施測方式之 C-DVT 於前、後測之平均分數的差異程度(Cohen, 1988)：$d \geq 0.2$ 代表 C-DVT 具輕度的練習效應；$d \geq 0.5$ 代表中度之練習效應；$d \geq 0.8$ 則代表練習效應嚴重 (Portney & Watkins, 2009)。

# 結果

表 1 呈現個案之人口學資料。共有 16 位個案參與本研究，平均分配於「增加練習時間」與「二次施測取平均」二個組別中。「原始施測組」的資料因抽取自「二次施測取平均」組，故個案之人口學資料與該組相同。整體而言，個案之平均年齡約為 59.3 歲，男女各半，患側以右手居多 (50.0%)、左手次之 (43.8%)，約有超過半數 (56.3%) 為阻塞型中風，個案平均發病時間為 2.1 年。人口學變項除增加練習時間組的年齡較大 ($p = 0.035$) 外，其餘變項（發病時間、MMSE、BI 和 NIHSS）二組均無統計顯著差異 ($p = 0.156$~$0.891$)。於 C-DVT 操作方面，二組個案都能對 C-DVT 做出正確反應，於初評與再評的 C-DVT 答錯率都很低 (1.3~2.6%)。

**表 1**

個案之人口學資料 ($N$ ＝ 16)

| 特性/組別 | 增加練習時間組 ($n$ ＝ 8) | 二次施測取平均組/原始施測組 ($n$ ＝ 8) |
|---|---|---|
| **性別，人(%)** | | |
| 男性 | 4 (50.0%) | 4 (50.0%) |
| 女性 | 4 (50.0%) | 4 (50.0%) |
| **年齡，年** | 65.3 ± 9.2 | 53.4 ± 9.8 |
| **患側，人(%)** | | |
| 左 | 4 (50.0%) | 4 (50.0%) |
| 右 | 3 (37.5%) | 4 (50.0%) |
| 雙 | 1 (12.5%) | 0 (0.0%) |
| **中風類型，人(%)** | | |
| 出血型 | 3 (37.5%) | 4 (50.0%) |
| 阻塞型 | 5 (62.5%) | 4 (50.0%) |
| **教育程度，人(%)** | | |
| 國小 | 3 (37.5%) | 3 (37.5%) |
| 國中 | 2 (25.0%) | 2 (25.0%) |
| 高中/高職 | 2 (25.0%) | 2 (25.0%) |
| 大學 | 1 (12.5%) | 1 (12.5%) |
| **發病時間，年** | 2.0 ± 1.2 | 2.1 ± 2.0 |
| **NIHSS，人(%)** | | |
| <8 | 8 (100.0%) | 6 (75.0%) |
| 8~10 | 0 (0.0%) | 2 (25.0%) |
| >14 | 0 (0.0%) | 0 (0.0%) |
| BI | 18.4 ± 2.6 | 19.8 ± 0.7 |
| **MMSE** | 27.4 ± 2.2 | 26.5 ± 2.8 |
| **C-DVT 於初評之答錯率(%)** | 1.9 ± 1.6 | 2.6 ± 4.8 |
| **C-DVT 於再評之答錯率(%)** | 1.3 ± 0.7 | 2.2 ± 2.0 |

表 2 呈現施測總時間（C-DVT 的主要指標）、隨機測量誤差、再測信度與練習效應的結果。施測總時間方面，增加練習時間組與二次施測取平均組的個案，於初評（平均 300.3 與 263.3 秒）與再評（286.5 與 249.9 秒）施測所需的時間均無顯著差異 ($p$ ＝ 0.089 與 0.122)。

**表 2**
C-DVT 之施測總時間、再測信度、隨機測量誤差與練習效應 ($N$ = 16)

| | 二次平均 | 增加練習 | 原始施測 |
|---|---|---|---|
| 初評（平均 ± 標準差）(秒) | 263.3 ± 48.5 | 300.3 ± 30.7 | 263.7 ± 48.9 |
| 再評（平均 ± 標準差）(秒) | 249.9 ± 27.9 | 286.5 ± 43.3 | 248.4 ± 25.8 |
| 差異（平均 ± 標準差）(秒) | 13.4 ± 27.1 | 13.8 ± 28.8 | 15.3 ± 29.1 |
| ICC (95% C.I.) | 0.74 (0.22~0.94) | 0.69 (0.11~0.93) | 0.70 (0.12~0.93) |
| SEM (%) | 19.8 (7.7) | 20.6 (7.0) | 21.1 (8.2) |
| MDC (%) | 54.9 (21.4) | 57.0 (19.4) | 58.5 (22.9) |
| 效應值 ($d$) | 0.34 | 0.37 | 0.39 |
| $p$ 值 | 0.207 | 0.217 | 0.181 |

隨機測量誤差的結果顯示：增加練習時間組的 MDC%最小 (19.4%)、二次施測取平均組次之 (21.4%)，而原始施測組最大(22.9%)。此結果與使用 MDC 為隨機測量誤差指標的趨勢不同：二次施測取平均組的 MDC 最小 (54.9)、增加練習時間組次之 (57.0)，原始施測組最大 (58.5)。

再測信度分析結果發現：二次施測取平均組最大 (ICC = 0.74)、原始施測方式次之 (0.70)，而增加練習時間最小 (0.69)。

練習效應的結果顯示：二次施測取平均組的分數差異最小 ($d$ = 0.34)，其次為增加練習時間 (0.37)，而以原始施測組最大 (0.39)。

# 討論

本研究發現增加練習時間組的隨機測量誤差 (MDC% = 19.4%) 和二次施測取平均組 (21.4%) 都略小於原始施測組 (22.9%)。此結果顯示二種施測方式似乎都有助於降低 C-DVT 的隨機測量誤差，但以增加練習時間的效果較好。由於 MDC%可用以判斷個案的分數改變是否超過隨機測量誤差（即檢視個案在前、後測的分數變化量，是否超過其平均得分乘以 MDC%的數值），故對臨床人員（或以評估個案分數變化為目標之使用者）而言，在正式施測 C-DVT 前增加 5 分鐘的練習時間，可能是較有潛力降低隨機測量誤差的方法。

本研究發現以 MDC 和 MDC%為隨機測量誤差指標的結果趨勢不同（以 MDC 為指標，則二次施測取平均的誤差較小）。此差異可能與本研究中二種施測方式組完成測驗所需的總時間（C-DVT 的主要指標）差異較大（如：初評時，增加練習時間組需 300.3 秒；二次施測取平均組則需 263.3 秒，$p = 0.009$）有關。由於 MDC% 的計算以各組完成測驗的平均時間為分母，有助於降低樣本差異所造成之影響。因此，相較於固定數值的 MDC，MDC%更適合用做為本研究隨機測量誤差的指標。

再測信度部份，我們發現二次施測取平均組的 ICC 較高 (0.74)，而增加練習時間的 ICC (0.69) 則與原始施測組相似 (0.70)。此結果顯示僅有二次施測取平均之施測方法可能有助於提升 C-DVT 的再測一致性；但增加練習時間的效果似乎有限。由於 ICC 為團體層級之信度指標，故對於研究人員（或以評估團體個案之平均分數的使用者）而言，二次施測取平均可能是較有潛力提升再測一致性的方法。

練習效應的結果顯示：二次施測取平均組 ($d = 0.34$) 與增加練習時間組 (0.37) 的效應值都比原始施測組 (0.39) 小。此結果顯示增加練習時間與二次施測取平均之施測方式似乎都能降低 C-DVT 的練習效應，但以二次施測取平均的效果較好。二次施測取平均組之練習效應較小，可能與正式測驗的練習效果優於練習題，造成該組個案於初、再測之第二次測驗的表現較為穩定有關。本研究結果顯示二次施測取平均可能是有效降低 C-DVT 之練習效應的方法，未來研究可比較不同練習方式（如：模擬正式測驗）或時間與題數對降低練習效應之影響。

本研究發現二種施測方式對 C-DVT 之隨機測量誤差與再測信度的影響不一致。造成上述影響不一致的可能原因為再測信度之指標 (ICC) 同時受到系統性偏誤（systematic bias, 如：練習效應）與隨機測量誤差影響。在本研究中，增加練習時間組的練習效應 ($d = 0.37$) 比二次施測取平均組大 (0.34)，此練習效應可能降低該組於初、再評分數的一致性，進而產生隨機測量誤差小但再測信度低的現象。

本研究中呈現 C-DVT 的隨機測量誤差、再測信度與練習效應都比昔日研究 (Yang et al., 2015) 差。隨機測量誤差的部份，本研究中三種施測方式的 MDC% (19.4%~22.9%) 都大於昔日研究 46.8 (15.4%, Yang et al., 2015)。再測信度部份，本研究中三種施測方式的 ICC (0.69~0.74) 都較昔日研究 (0.92) 低；而練習效應的部份，本研究中發現三種施測方式的效應值 ($d = 0.34$~0.39) 都比昔日研究 (0.15,

Yang et al., 2015) 大。本研究發現增加練習，可能與本研究樣本數較小造成取樣偏誤（如：樣本數少而未包含持續性注意力較差或較佳的個案），進而低估樣本之變異程度有關。在本研究中，三種 C-DVT 施測方式組別於初、再評之變異程度（標準差 ＝ 25.8~48.9 秒）都比昔日研究（54.4~64.8 秒）小，而本研究檢驗之三種指標（MDC%、ICC 與 Cohen’s *d*）都受樣本變異影響，例如：ICC 之估算依據為樣本變異（個案間施測結果的變異）與再測變異（初、再測之變異）的相對比率(Shrout & Fleiss, 1979)：當樣本變異較小時，ICC 的數值亦較低；又如 Cohen’s *d* 的算式亦包含初、再評之樣本變異 (Cohen, 1988)：當初、再評之樣本變異小時，效應值較大。此問題樣本可透過增加樣本數與個案異質性（如：不同嚴重度）之方式解決。然而，本研究之主要目的（二種施測方式降低 C-DVT 隨機測量誤差、再測信度與練習效應的趨勢）屬於驗證上述數值之相對排序而非絕對數值，而樣本數小的問題對此相對排序之影響有限，故不影響本研究對降低隨機測量誤差之趨勢的判讀。

本研究之限制有二：(1) 本研究採方便樣本且樣本數小，可能存有取樣偏誤，故本研究結果之類化能力有限。(2) 原始施測組的資料抽取自二次施測取平均組，可能低估原始施測組的隨機測量誤差，進而低估二次施測取平均組降低隨機測量誤差的效果。未來研究宜增加樣本數（如：每組 30 人），並增加原始施測組，以實際比較三種施測方式對 C-DVT 之再測信度、隨機測量誤差與練習效應的影響。

## 結論

本研究呈現二種施測方式（二次施測取平均與增加練習時間）對 C-DVT 之隨機測量誤差的影響趨勢：二種施測方式貌似都有助於降低 C-DVT 的隨機測量誤差，但以增加練習時間的效果可能較好。此結果支持 C-DVT 正式施測時間前增加 5 分鐘的練習時間，或為較有效降低隨機測量誤差的方法。然而，我們也發現對提升再測信度與降低練習效應而言，二次施測取平均降低 C-DVT 的效果可能較佳。未來研究宜增加樣本數，以確認增加練習時間降低 C-DVT 之隨機測量誤差的效果。

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# 參考文獻

Aaronson, N., Alonso, J., Burnam, A., Lohr, K. N., Patrick, D. L., Perrin, E., & Stein, R. E. (2002). Assessing health status and quality-of-life instruments: attributes and review criteria. *Quality of Life Research, 11*, 193-205.

Agrell, B., & Dehlin, O. (2000). Mini mental state examination in geriatric stroke patients. Validity, differences between subgroups of patients, and relationships to somatic and mental variables. *Aging, 12*, 439-444.

Beckstead, J. W. (2013). On measurements and their quality: Paper 2: Random measurement error and the power of statistical tests. *International Journal of Nursing Studies, 50*, 1416-1422.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates.

Flansbjer, U. B., Holmback, A. M., Downham, D., Patten, C., & Lexell, J. (2005). Reliability of gait performance tests in men and women with hemiparesis after stroke. *Journal of Rehabilitation Medicine, 37*, 75-82.

Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research, 12*, 189-198.

Grace, J., Nadler, J. D., White, D. A., Guilmette, T. J., Giuliano, A. J., Monsch, A. U., & Snow, M. G. (1995). Folstein vs modified Mini-Mental State Examination in geriatric stroke. Stability, validity, and screening utility. *Archives of Neurology, 52*, 477-484.

Green, M. F. (2006). Cognitive impairment and functional outcome in schizophrenia and bipolar disorder. *Journal of Clinical Psychiatry, 67* (10), e12.

Haley, S. M., & Fragala-Pinkham, M. A. (2006). Interpreting change scores of tests and measures used in physical therapy. *Physical Therapy, 86*, 735-743.

Hsueh, I. P., Lee, M. M., & Hsieh, C. L. (2001). Psychometric characteristics of the Barthel activities of daily living index in stroke patients. *Journal of the Formosan Medical Association, 100*, 526-532.

Hsueh, I. P., Lin, J. H., Jeng, J. S., & Hsieh, C. L. (2002). Comparison of the psychometric characteristics of the functional independence measure, 5 item Barthel index, and 10 item Barthel index in patients with stroke. *Journal of Neurology, Neurosurgery and Psychiatry, 73*, 188-190.

Hyndman, D., & Ashburn, A. (2003). People with stroke living in the community: Attention deficits, balance, ADL ability and falls. *Disability and Rehabilitation, 25*, 817-822.

Hyndman, D., Pickering, R. M., & Ashburn, A. (2008). The influence of attention deficits on functional recovery post stroke during the first 12 months after discharge from hospital. *Journal of Neurology, Neurosurgery and Psychiatry, 79*, 656-663.

Lu, W. S., Huang, S. L., & Hsieh, C. L. (2009). Several trials are useful to reduce the value of minimal detectable change. *Archives of Physical Medicine and Rehabilitation, 90*, 181-182; author reply 182-183.

Lyden, P., Raman, R., Liu, L., Grotta, J., Broderick, J., Olson, S., . . . Marler, J. (2005). NIHSS training and certification using a new digital video disk is reliable. *Stroke, 36*, 2446-2449.

Mahoney, F. I., & Barthel, D. W. (1965). Functional Evaluation: The Barthel Index. *Maryland State Medical Journal, 14*, 61-65.

Portney, L. G., & Watkins, M. P. (2009). *Foundations of clinical research: applications to practice*. Upper Saddle Rive: Prentice Hall.

Schreuders, T. A., Roebroeck, M. E., Goumans, J., van Nieuwenhuijzen, J. F., Stijnen, T. H., & Stam, H. J. (2003). Measurement error in grip and pinch force measurements in patients with hand injuries. *Physical Therapy, 83*, 806-815.

Shrout, P. E., & Fleiss, J. L. (1979). Intraclass correlations: uses in assessing rater reliability. *Psychological Bulletin, 86*, 420-428.

Virk, S., Williams, T., Brunsdon, R., Suh, F., & Morrow, A. (2015). Cognitive remediation of attention deficits following acquired brain injury: A systematic review and meta-analysis. *NeuroRehabilitation, 36*, 367-377.

Yang, C. M., Lin, G. H., Chen, M. H., Hsueh, I. P., & Hsieh, C. L. (2015). Development of a computerized Digit Vigilance Test and validation in patients with stroke. *Journal of Rehabilitation Medicine*, 47, 311-317.

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Original article

# Reducing the Random Measurement Error of the Computerized Digit Vigilance Test in Patients with Stroke: A Preliminary Study

OCCUPATIONAL THERAPY

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## Abstract

The Computerized Digit Vigilance Test (C-DVT) is an efficient and valid measure of sustained attention that has a great potential to be used routinely in clinical settings. However, the random measurement error of the C-DVT remains large. The purpose of this study was to investigate potential methods of administration to minimize random measurement errors of the C-DVT. Test-retest reliability and practice effects of these methods were also compared. Sixteen patients with stroke were randomly assigned to two groups (i.e., "increased practice time" and "averaging two assessments") with each of 8 patients. The results of the original C-DVT group were extracted from the "averaging two assessments" group (i.e., the first testing at the pre- and post-assessments). Regarding the random measurement error, we found that both "increased practice time" (19.4%) and "averaging two assessments" (21.4%) groups had smaller percentages of minimal detectable change than that of the "original C-DVT group" (22.9%). Considering test-retest reliability, only the "averaging two assessments" group had a higher intraclass correlation coefficient (0.74) than that (0.69~0.70) of the others. About practice effect, both "increased practice time" ($d$ = 0.34) and “averaging two assessment sets" (0.37) groups had smaller effect sizes than that (0.39) of the "original C-DVT" group. Our findings support that increased practice time has the potential to reduce random measurement errors of the C-DVT; whilst averaging two assessments may be a better choice for reducing test-retest reliability and practice effect. Further study can verify effect of increased practice time on random measurement error with a larger sample size.

***Keywords:*** *Computerized Digit Vigilance Test, Stroke, Random Measurement Error*

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