職能治療學會雜誌
民國一0一年 第三十卷 第一期

目錄

Journal of Taiwan Occupational Therapy Association

Volume 30, Number 1, 2012

Table of Contents

職能治療學會雜誌通訊課程說明

本會為推動「通訊課程」以服務會員並提升會員之研究知能，提供更多元方式可使職能治療人員取得繼續教育積分，會於各期的職能治療學會雜誌刊登之內容中選取兩篇為「通訊課程」，並擬定試題，申請衛生署職能治療學學雜誌通訊課程積分認證供會員申請。

對 象：本會會員。

方 法：

1.需閱讀完本期雜誌之「通訊課程」文章，回答測驗題，並將答案填寫於期刊中之專用答案紙。

2.請將答案紙e-mail(otaroc@ms13.hinet.net)或傳真(02-23826496)回覆。會員必須於本期雜誌發行後3個月之內完成作答與回覆，否則不予計分。

3.測驗分數達80分以上者，即可獲得2學分，可自行至衛生署繼續教育積分管理系統查詢(http://cec.doh.gov.tw)。

4.試題答案將於下一期之期刊刊登，同時寄發通知給參與「通訊課程」之會員。

5.相關辦法：職能治療師執業登記及繼續教育辦法第九條第六點

參加職能治療學雜誌通訊課程者，每次積分2點。但超過30點者，以30點計。

6.訂購：售價每本新台幣300元整。(本會會員免費贈閱)。

郵政劃撥帳號：07463332；戶名：社團法人臺灣職能治療學會。

7.以上說明若有問題，請洽本會秘書處。

30卷第一期 通訊課程測驗

請將答案填寫於對應的空格

中風病患與家屬對職能治療之認識程度初探				
1	2	3	4	5

是非題

1. 職能治療知識的定義是與職能治療相關，而且對病患與家屬重要的知識。

2. 本研究顯示接受職能治療服務越久的個案與家屬，越瞭解職能治療。

3. 本研究顯示中風個案與家屬具備充足的職能治療知識。

選擇題

4. 中風個案與家屬自覺最需要的職能治療知識為何？
   (A) 服務項目
   (B) 活動目的
   (C) 治療目標
   (D) 職能治療的定義

5. 下列何者為中風個案與家屬較偏好之資訊傳遞方式？
   (A) 衛教單張
   (B) 衛教手冊
   (C) 醫院電視
   (D) 網頁介紹

增進唐氏症兒童體適能之研究				
1	2	3	4	5

1. 關於唐氏症（Down syndrome）的描述，下列何者不正確？
   (A) 是造成智能障礙的主要原因之一
   (B) 唐氏症兒童多數為輕度智能障礙
   (C) 會有肌肉張力過低的情形
   (D) 發展預後個別差異大
   (E) 較偏好靜態的生活方式

2. 文獻當中認為影響唐氏症兒童體適能最主要的原因為？
   (A) 被動的生活方式與習慣
   (B) 身高與體重，
   (C) 認知障礙
   (D) 動作功能較差
   (E) 以上皆是

3. 利用虛擬實境遊戲介入的優點，包括：
   (A) 可提供個案多重感覺刺激
   (B) 可讓個案有自我選擇的機會
   (C) 可提高個案的動機
   (D) 可讓個案隨時矯正自我的姿勢動作
   (E) 以上皆是

4. Bruininks-Oseretsky Test of Motor Proficiency-Second Edition (BOT-2)中最適合用來評估兒童肌肉力量及敏捷性等體適能之次測驗為？
   (A) fine manual control
   (B) manual coordination
   (C) body coordination
   (D) strength and agility
   (E) 以上皆可

5. The Improved Cooper Test施測的方式主要是評量個案在幾分鐘之內可行走的距離？
   (A) 5
   (B) 10
   (C) 12
   (D) 15
   (E) 20

29卷第二期勘誤表

中風病人自覺職能治療照護品質問卷- PROTS 發展: 向度與題目編制

蕭宇佑等人

1. 標題的編制改為編製

職能治療學會雜誌
民國 101 年 30 卷第 1 期頁 7-33

以人因觀點及運動學表現探究鋼琴彈奏之手部傷害機制

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摘要

目前與鋼琴彈奏相關之研究多以流行病學議題為主，為能更完整地瞭解鋼琴彈奏之傷害機制，本研究之目的為應用客觀量化之生物力學方法，探討手距 (hand span) 大小對彈奏和絃及八度音樂曲時之運動學差異，並探究左右手在彈奏時之運動學表現，以期將研究結果與臨床應用做結合。本研究招募十六位鋼琴彈奏者，所有受測者皆需接受手距大小之標準量測，及重複彈奏指定之和絃及八度音樂曲片段各五次。彈奏時使用三維動作分析儀捕捉手部三維資料，並計算出最大指間外展角度比值、指關節之屈曲伸展活動度及指關節之屈曲伸展動作單元等運動學參數。結果顯示，大手距與小手距組於彈奏和絃及八度音時，最大指間外展角度比值達到顯著之統計差異。兩組在指關節屈曲伸展活動度上較無顯著差異。但就左右手之各指指關節屈曲伸展動作單元，右手顯著大於左手。故小手距者於彈奏和絃及八度音時，易有手指過度外展現象，推論此可能易導致手部相關內在肌群傷害的產生。此外，右手於彈奏樂曲時，比起左手有更多不自主的手指預備彈奏動作產生，此呼應右手較易產生傷害之論點。本研究由手部動作表現解釋相關疾病之成因，期可提供臨床診斷、介入及音樂教育上實值之運用。

關鍵字：鋼琴彈奏者，人因工學，運動學，手部傷害

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受文日期：民國100年12月24日
接受刊載：民國101年 3月4日

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前言

鋼琴彈奏者可視為一人數眾多的職能團體，此鋼琴彈奏之職能活動可為某些人之生涯工作或為某些人之娛樂休閒 (Bragge, Bialocerkowski, & McMeeken, 2006a)。媒體上常有一些關於「小朋友是不是可以練鋼琴」、「幾歲開始練鋼琴較適合」、或「練鋼琴會不會造成手部或上肢傷害」等報導，這些報導對於家長、老師及學習者均有所衝擊及影響，然關於樂器彈奏與傷害的文獻，目前多著重於流行病學之調查研究，且結果均指出演奏樂器與傷害間確實存在相關性，但這些傷害是如何造成的，其致病機制又為何，卻鮮少能從現有之研究報告中得到合理及足以說服大眾之證據。

鋼琴彈奏為需要手部肌肉骨骼及神經系統有高度協調及控制能力的活動，當此協同機制破壞後必然會影響彈奏表現，這也是所有鋼琴彈奏者所不樂見之情況。然而，從目前與鋼琴彈奏相關的臨床流行病學文獻中指出：約有40 %至80 %的鋼琴彈奏者主訴有與彈奏相關之肌肉骨骼疼痛、疾病或與神經損傷相關的問題發生 (Bejjani, Kaye, & Benham, 1996; Blackie, Stone, & Tiernan, 1999; De Smet, Ghyselen, & Lysens, 1998; Eri Yoshimura, Paul, Aerts, & Chesky, 2006; Furuya, Nakahara, Aoki, & Kinoshita, 2006; Grieco et al., 1989; Pak & Chesky, 2001; Revak, 1989; Tsai, Huang, & Hsieh, 2007)。許多專業的鋼琴彈奏者，因社會與自我期待，更易有完美主義傾向 (Perfectionism)，進而選擇忽略疼痛等問題，期許能有更長的練習時間與更佳的演奏表現，同時也因職業生存競爭，而隱藏病痛等問題 (culture of silence)，帶著疼痛感繼續練習樂曲 (Bragge, Bialocerkowski, & McMeeken, 2006a, 2006b; Tsai et al., 2007)。大部分之鋼琴彈奏者，仍以自行處理肌肉骨骼疼痛問題者居多，如縮短練習時間、拉長休息時間及冰敷熱敷以緩解疼痛問題等，極為少數的彈奏者在發現疼痛後會積極尋求醫療協助 (Blackie et al., 1999; Furuya et al., 2006)。造就此一現象，可能與現今醫療體系仍舊缺乏與音樂醫療相關之專業支持，如醫師的診斷與治療師之介入與諮詢 (Furuya et al., 2006)，以及在基礎音樂教育中未能將傷害預防的觀念導入等有關。

與鋼琴彈奏相關之傷害中最常見的診斷有外在肌或內在肌之肌腱炎

(tendonitis)、肱骨內上髁炎 (medial epicondylitis)、肱骨外上髁炎 (lateral epicondylitis)、腱鞘炎 (tenosynovitis)，其中腱鞘炎最常好發之診斷為俗稱之媽媽手 (de Quervain's disease) 及食指至小指屈肌腱鞘炎 (2nd-5th flexor tenosynovitis) (Dawson, 2002; Sakai, 1992, 2002; Tsai et al., 2007; Zaza, 1998; Zaza, Charles, & Muszynski, 1998)。除肌腱或腱鞘外，另常見與鋼琴彈奏相關的診斷為周邊神經壓迫症候群 (peripheral nerve entrapment syndromes)，包括腕隧道症候群 (carpal tunnel syndrome)、尺神經病變 (ulnar neuropathy)、頸椎根神經病變 (cervical radiculopathy)、及局部肌張力異常 (focal dystonia) 等 (Bejjani et al., 1996; Dawson, 2002; Lederman, 2003; Sakai, 2002; Zaza, 1998; Zaza et al., 1998)。多數彈奏者主訴的嚴重症狀仍以疼痛為主 (Blackie et al., 1999; Bragge et al., 2006b; Lederman, 2003; Revak, 1989; Shields & Dockrell, 2000)，且疼痛發生部位通常不僅侷限於單純某個部位 (De Smet et al., 1998; Eri Yoshimura et al., 2006)，而是好發於多個部位，尤其以手腕及手掌、指有較高之好發率，其中手指又以拇指、無名指與小指之好發情形最為嚴重 (Blackie et al., 1999; Chung, Ryu, Ohnishi, Rowen, & Headrich, 1992; De Smet et al., 1998; Furuya et al., 2006; Goodman & Staz, 1989; Grieco et al., 1989; Lederman, 2003; Pak & Chesky, 2001; Revak, 1989; Sakai, 1992; Shields & Dockrell, 2000)。Furuya等人 (2006) 整理分析206份日本女性鋼琴彈奏者之問卷調查，高達109位受測者有手部肌肉或骨骼系統疼痛問題。伍鴻沂與陳嘉炘 (民 98) 亦針對某大學音樂系學生做樂器彈奏傷害之調查，其中有高達45.8%的學生有因彈奏樂器所致之肌肉骨骼傷害。

回顧文獻，引起鋼琴彈奏者產生肌肉骨骼疾病之危險因子很多，包括性別、年齡、手距大小、練習時間長短、及彈奏技巧等，大部份之文獻仍以分析問卷及相關人口學資料為主，以推論相關因子與傷害間之相關性。問卷調查研究結果均提出女性鋼琴彈奏者之的肌肉骨骼疾病盛行率較高，主要原因可能與女性的解剖構造相關，女性的軀幹、肢體或手部比起男性普遍皆較為嬌小所致，因此，研究指出手部尺寸較小之鋼琴演奏者較容易患有與彈奏相關之肌肉骨骼疾病 (De Smet et al., 1998; Donison & Mus, 2000; Eri Yoshimura et al., 2006; Sakai, 1992, 2006; Wagner, 1988)。Sakai等人 (2006) 將探討鋼琴彈奏者之手距大小與過度使用症候

群作間的相關性，結果指出小手距之鋼琴彈奏者需使用較大之大拇指外展角度彈奏特殊音樂技巧，過大之手指外展角度可能因此導致手部疼痛之好發率偏高。Eri Yoshimura等人 (2006) 使用靜態照像法探討手指間之主動動作，計算大拇指及食指、食指及中指、中指與無名指、及無名指與小指之指間外展角度，結果發現大拇指與食指的指間外展角度佔了手距大小的一大部份，與疼痛有很大的相關性，同時其結果指出右手中指與無名指指間外展角度大小亦為一個重要的危險因子。

特殊彈奏技巧亦被先前學者認為是引起傷害的危險因子之一 (Chung et al., 1992; Parlitz, Peschel, & Altenmuller, 1998; Sakai, 1992; Sakai, Liu, Su, Bishop, & An, 1996; Sakai et al., 2006)，不同的彈奏技巧容易導致不同傷害的產生 (Sakai, 1992, 2002; Sakai et al., 1996; Sakai et al., 2006; Shields & Dockrell, 2000)。Sakai (1992) 探討了日本鋼琴彈奏者之疼痛問題，結果指出四十位有手部疼痛問題之鋼琴彈奏者中有三十位認為彈奏和絃 (chord) 及八度音 (octave) 技巧會增加疾病疼痛的嚴重程度。Shields 與 Dockrell (2000) 探討了愛爾蘭音樂學校鋼琴演奏者之傷害發生率，其中52 %的受測者曾經於練習八度音技巧時遭遇疼痛的問題，故鋼琴彈奏者持續練習和絃或八度音等需外擴手指之技巧，被認為是容易增加手部疼痛問題的產生。

不可否認的，探究鋼琴彈奏所致之傷害是無法跟力學原理脫離關係的，而有關鋼琴彈奏時之生物力學研究約略在二十年前才開始受到重視。利用生物力學研究於音樂演奏活動之身體功能表現，可深入了解肌腱、肌肉、骨頭及關節如何對應外在環境的出力及負重 (An & Bejjani, 1990)。另外，以人因的觀點來看鋼琴彈奏表現，亦是呈現出未盡合理之處，如以彈奏鋼琴的族群而言，分布著不同的性別、人體計測特徵（如手指之長短、寬度或手撐開至最大之距離等），但市售之鋼琴琴鍵寬度卻始終為一定尺寸，若以年齡觀點著手探究，更深具矛盾之處，從一個人四歲時所彈奏的鋼琴，到二十歲時仍是彈奏一樣尺寸的琴，是否這些人因參數與琴鍵設計和前述引起鋼琴彈奏者產生肌肉骨骼疾病，特別是在手掌內部的內在肌群疼痛及傷害有所關聯，依目前的文獻證據的確難以證實，但此確實是一個值得去探究之議題。故本研究之動機為運用目前已廣泛發展之客觀且量化生物力學分析方法，來探討手距大小及左右手等手部參數於彈奏鋼琴時之運動學表現差

異，藉以推論相關危險因子、運動學參數與肌肉骨骼傷害間的相互影響關係。本研究之主要具體目標為探討鋼琴彈奏者於彈奏兩種不同技巧（和絃、八度音）的樂曲時，手距 (hand span) 大小及左右手因子是否會影響運動學的表現，進而推究是否可能為造成手部肌肉或肌腱疼痛及傷害之成因機轉。

研究方法

一、研究對象

本研究以方便取樣及滾雪球取樣法招募十六位女性鋼琴彈奏者為研究對象，研究內容通過國立成功大學醫學院附設醫院人體試驗委員會審核，所有受測者於正式參與研究前皆需簽署「國立成功大學醫學院附設醫院−快速審查受試者同意書」，並清楚了解本研究之目的及施測流程等。受測者之收案標準為：(一)、擁有大學以上音樂系學歷之鋼琴老師或音樂系老師，及主副修鋼琴之音樂系（班）學生，(二)、年齡於十八歲以上，(三)、慣用手為右手，(四)、鋼琴練習時間至少每週七個小時，(五)、可彈奏本研究所指定的兩首樂曲片段，與（六）、符合下述所定義之大手距與小手距標準。受測者若有下列條件即予以排除：(一)、自我疼痛評估在對照疼痛量表為兩分以上，與(二)、經醫師診斷為手部有相關之類風濕性或退化性關節疾病、現存三個月內之肌腱炎、肌腱滑囊炎及週邊神經病變症候群或先前曾有手部重大之創傷意外。

本研究將十六位受測者分成大手距與小手距兩組，每組各八位。由於目前國內人體計測資料庫並無與手距相關之量測資料，故本研究先針對六十位女性受測者之手部作手距之量測，量測方法為要求受測者將手掌及手腕平鋪於桌面，並將所有手指打開至最大的角度，以標準卡尺 (caliper) 量測大拇指指尖至小指指尖的距離。依此六十位女性受測者之手距數據分佈，以四分位法取所有受測者右手手距之前四分之一數據定義為本研究小手距之收案標準；取後四分之一數據定義為大手距之收案標準。此六十位女性受測者平均年齡為22.2 ± 3.1歲，右手手距平均為19.3 ± 1.2公分，以柯-史單樣本考驗 (one-sample Kolmogorov-Smirnov test) 檢驗

此60位受測者之數據分佈，其結果並未達 .05顯著水準 (Z = .927, p = .356)，故此60位受測者之手距分佈屬常態分佈，故將小手距收案標準定義為18.2公分以下；大手距之收案標準定義為20.2公分以上，故本研究中若招募之受測者手距介於18.2至20.2公分間即予以排除。

二、研究設備及流程

(一)、基本資料表

受測者基本資料表內容包括姓名、年齡、性別、左側及右側之手距大小等。

(二)、 數位鋼琴

本研究使用卡西歐CDP-100型號之數位鋼琴 (CASIO, Taiwan Co., Ltd.)，包含了與直立式鋼琴琴鍵數相同之八十八個力度動作鍵盤，其琴鍵觸感與直立式鋼琴觸感亦極為類似。數位鋼琴與常見的傳統直立式鋼琴最大的差異在於聲音製造的部分，傳統鋼琴主要以打擊槌敲擊琴弦而發出聲音，而數位鋼琴的琴音則是以數位技術錄製傳統鋼琴的琴音而來。本研究所使用之數位鋼琴配備有可調式座椅，調整受測者之高度至符合肘關節屈曲90度，且前臂平行且略高於琴鍵，維持所有受測者的姿勢為一致的自然彈奏姿勢。

(三)、指定樂曲

本研究中所指定之兩首樂曲片段皆由徹爾尼練習曲中所擷取，第一首為徹爾尼849作品集第28首中 (CZERNY Op.849 ***28***) 之樂曲片段，以和絃技巧為主，受測者之右手須重覆且快速的以拇指、中指及小指同時彈奏琴鍵，左手則以伴奏音為主。第二首為徹爾尼337作品集第40首中 (CZERNY Op.337 ***40***) 之樂曲片段，以八度音技巧為主，受測者之左右手皆需以外展手指姿勢反覆地彈奏琴鍵。本研究指定受測者於正式施測時，彈奏此兩首樂曲各五次。

(四)、運動學研究設備及分析

本研究使用三維動作分析儀 (Eagle Motion Analysis Corporation, Santa Rosa, CA, USA）來進行受測者彈奏鋼琴之手部動作擷取，以60赫茲之頻率量測及收集彈奏時之手部關節三維空間位置數據資料，此分析儀包括一工作站及8台數位攝影機。本研究將40顆直徑為兩毫米之反光標記，分別黏貼於受測者雙手之食指、中指、無名指及小指指尖 (fingertip)、遠端指關節 (distal interphalangeal, DIP)、近端指關節 (proximal interphalangeal, PIP)、掌指關節 (metacarpophalangeal, MCP) 及掌骨中間點 (midpoint of metacarpal bone），此外，將16顆兩毫米反光標記黏貼於雙手大拇指指尖、指關節 (interphalangeal, IP)、掌指關節 (MCP joint) 及腕掌關節 (carpometacarpal, CMC)，因考量大拇指之動作為三個自由度，故採用T型標記以定義掌指關節及腕掌關節之座標系位置，為了定義手腕關節之動作，在受測者雙手手腕關節上各黏貼三顆反光標記，本研究之反光標記黏貼位置詳見圖1。所擷取之影像資料經EVaRT 4.2軟體 (Motion Analysis Corporation, Santa Rosa, USA) 進行軌跡辨認及訊息處理，獲知各反光標記與實驗室標記之相對位置後，利用MATLAB程式軟體將原始資料轉換並計算出本研究欲探討之運動學參數，為了去除雜訊，本研究以三階低通濾波器，截止頻率 (cutoff frequency) 設定為3Hz以處

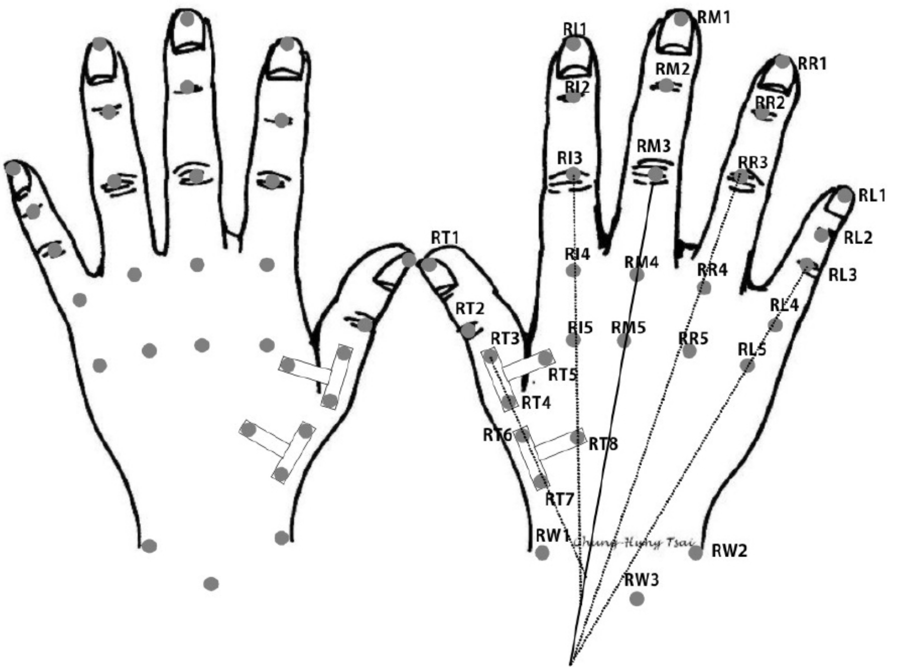

圖1
六十二顆反光標記黏貼位置圖

本研究探討之運動學參數及定義如下所示：

1. 各指最大指間外展角度比值：各手指於動態時之最大外展角度除以各指於靜態時之最大外展角度，再乘以100%，可得一個標準化後的值，即代表受測者於彈奏鋼琴時其各手指的外展角度使用百分比。其座標系定義為以中指RM3標記與RM4標記間之向量當作基準線，食指、無名指及小指以其近端指關節標記與掌指關節標記間之向量相對於中指之基準線，大拇指則以RT3標記與RT6標記間之向量相對於中指之基準線，利用此方法計算出各手指之最大指間外展角度（圖1）。

2. 指關節之屈曲伸展活動度：將各指關節於彈奏過程中之屈曲伸展最大角度減最小角度，即得各指關節於彈奏過程中的屈曲伸展活動度。因拇指之指關節、其他四指之遠端指關節及近端指關節皆為樞紐關節，僅有單一自由度動作，故其座標系定義直接計算該指關節前後兩個向量所組成之角度，使用單純之向量內積法即可求出伸展與屈曲角度。拇指之掌指關節、腕掌關節及其他四指之掌指關節，因關節動作有兩個以上之自由度，故以尤拉角方法以計算出各關節之伸展屈曲角度。

3. 各指關節之屈曲伸展動作單元 (movement unit)：利用微分方程式以計算受測者於彈奏過程中，各關節於屈曲伸展動作中有多少加速及減速的過程，計算出的加速減速總數目即代表屈曲伸展動作單元，可推論左手及右手於彈奏時之平順度。

三、資料統計分析

統計分析以SPSS第13版 (SPSS Inc., Chicago, IL, USA) 對本研究收集之資訊做分析及處理。描述性統計用以分析研究對象之人口學基本資料、手距大小等。由於樣本總數少於三十人及本研究之取樣必須通過手距大小之篩選，故樣本數為不對稱之分佈，故採用無母數統計分析方法，以曼−惠特尼*U*檢定法 (Mann-Whitney *U* test) 比較大手距與小手距兩組分別在彈奏和絃及八度音樂曲下之各指最大指間外展角度比值、指關節之屈曲伸展活動度等參數上是否有達到差異。另以威爾卡

森符號等級檢定法 (Wilcoxon signed-rank test) 比較彈奏雙手一致旋律之和絃及八度音樂曲時，各受測者之左手與右手在各指關節之屈曲伸展動作單元是否有達到差異。所有統計檢定方法以p值小於 .05為有顯著意義。

結果

一、受測者基本資料

本研究之樣本數為16位女性鋼琴受測者，平均年齡為22.4 ± 2.3歲，所有受測者為主副修鋼琴之音樂系（班）學生、且慣用手皆為右手。

本研究依受測者之手距大小分成兩組，大手距組為8位受測者，右手手距平均為21.3 ± 0.6公分，左手手距平均為21.6 ± 0.5公分。小手距組為8位受測者，右手手距平均為18.0 ± 0.1公分，左手手距平均為18.8 ± 0.3公分，本研究受測者之基本人口學資料如表1。

二、手距大小組在左右手最大指間外展角度比值之差異

彈奏和絃樂曲時（表2），小手距組之各指最大指間外展角度比值皆大於大手距組，且兩組在右手拇指 ($p < .01$)、右手食指 ($p < .01$)、左手拇指 ($p < .01$) 及左手無名指 ($p < .01$) 皆達到統計上之顯著差異。

彈奏八度音樂曲時（表3），小手距組之各指最大指間外展角度比值亦大於大手距組，且兩組在右手拇指 ($p < .01$)、右手食指 ($p < .05$)、左手拇指 ($p < .01$)、左手食指 ($p < .05$)、左手無名指 ($p < .01$) 及左手小指 ($p < .05$) 皆達到統計上之顯著差異；僅右手無名指及小指無達到顯著差異 ($p > .05$)。

表1
所有受測者之基本人口學資料

鋼琴彈奏者	年齡 (ys)	鋼琴經驗 (ys)	右手手距 (公分)	左手手距 (公分)
S1	22	19	18.00	18.35
S2	21	18	17.80	19.00
S3	21	17	18.20	19.20
S4	22	18	18.10	18.70
S5	22	21	17.90	19.00
S6	28	20	18.10	18.60
S7	22	18	18.00	19.00
S8	25	18	18.00	18.40
Mean (*SD*)	22.9 (2.4)	18.6 (1.3)	18.0 (0.1)	18.8 (0.3)
L1	22	17	21.50	21.85
L2	25	17	20.80	21.20
L3	21	15	21.00	21.60
L4	22	16	22.00	22.00
L5	22	14	21.00	20.90
L6	25	20	20.80	21.10
L7	19	13	21.10	21.50
L8	19	11	22.40	22.30
Mean (*SD*)	21.9 (2.3)	15.4 (2.8)	21.3 (0.6)	21.6 (0.5)
Group mean (*SD*)	22.4 (2.3)	17.0 (2.7)		

註：S1-S8代表小手距組 (small hand span) 共8人。
L1-L8代表大手距組 (large hand span) 共8人。

表2
手距大小於彈奏和絃之最大指間外展角度比值差異

$R_{max.abd}$_Chord	平均值(標準差)		Z	*p*
	大手距組 (*n* = 8)	小手距組 (*n* =8)		(2-tailed Sig.)
R_thumb (%)	56.3 (11.6)	90.5 (17.5)	-3.15	.002**
R_index finger (%)	61.1 (25.8)	107.3 (31.0)	-2.63	.009**
R_ring finger (%)	87.1 (30.7)	107.3 (28.5)	-1.47	.141
R_little finger (%)	81.0 (19.8)	97.8 (17.2)	-1.79	.074
L_thumb (%)	74.9 (16.8)	103.5 (13.6)	-3.05	.002**
L_index finger (%)	101.0 (19.2)	119.5 (27.4)	-1.47	.141
L_ring finger (%)	68.5 (16.0)	112.0 (16.7)	-3.26	.001**
L_little finger (%)	66.1 (15.2)	86.7 (20.1)	-1.68	.093

註：$R_{max.abd}$:各指最大指間外展角度比值；Chord: 和絃樂曲。
$^{**}p < .01$。

表3
手距大小於彈奏八度音之最大指間外展角度比值差異

$R_{max.abd}$_Octave	平均值(標準差)		Z	*p*
	大手距組 ($n = 8$)	小手距組 ($n = 8$)		(2-tailed Sig.)
R_thumb (%)	94.5 (16.8)	125.5 (13.2)	-3.05	.002**
R_index finger (%)	67.7 (24.5)	106.0 (28.1)	-2.31	.021*
R_ring finger (%)	87.1 (33.1)	110.8 (26.4)	-1.47	.141
R_little finger (%)	99.2 (19.3)	106.4 (7.7)	-1.37	.172
L_thumb (%)	85.0 (14.7)	117.3 (17.6)	-2.73	.006**
L_index finger (%)	74.9 (22.5)	103.7 (20.9)	-2.42	.016*
L_ring finger (%)	64.2 (23.8)	105.7 (19.7)	-2.84	.005**
L_little finger (%)	77.8 (21.3)	104.0 (12.6)	-2.10	.036*

註： $R_{max.abd}$:各指最大指間外展角度比值；Octave: 八度音樂曲。
$^{*}p < .05$. $^{**}p < .01$。

三、手距大小組在左右手指關節屈曲伸展活動度之差異

手距大小兩組於彈奏兩首指定樂曲時，雙手各指關節屈曲伸展活動度之分析結果可參照表4及表5。結果顯示彈奏和絃樂曲時，各手指指關節之屈曲與伸展活動度在大手距及小手距兩組中，皆未達統計上之顯著差異 ($p > .05$)。彈奏八度音樂曲時，各手指指關節之屈曲與伸展活動度在大手距及小手距此兩個族群中，於右手拇指掌指關節 (MCP joint) ($p < .05$)、右手中指遠端指關節 (DIP joint) 及近端指關節 (PIP joint) ($p < .05$)、左手中指之掌指關節 (MCP joint) ($p < .05$) 達到統計上之顯著差異，其餘雙手指關節皆未達統計上之顯著差異 ($p > .05$)。

四、左右手指關節之屈曲伸展動作單元差異

彈奏雙手旋律一致之和絃樂曲時，右手拇指各指關節之屈曲伸展動作單元，皆多於左手拇指，且有達到統計上之顯著差異 ($p < .01$)。右手食指、中指、無名指及小指各指關節之屈曲伸展動作單元，亦多於左手各指關節，且皆有達到統計上之顯著差異 ($p < .01$)，統計分析結果可參照表6。

彈奏八度音樂曲時 ，右手拇指各指關節之屈曲伸展動作單元，皆多於左手拇

指，且有達到統計上之顯著差異 ($p < .01$)。右手食指、中指、無名指及小指各指關節之屈曲伸展動作單元，亦多於左手各指之指關節，且皆有達到統計上之顯著差異 ($p < .05$)，統計分析結果可參照表7。

討論

一、手距大小對最大指間外展角度比值之差異性探討

研究結果顯示，小手距之鋼琴彈奏者於彈奏和絃及八度音樂曲時，其雙手指間的外展角度使用百分比皆大於大手距之鋼琴彈奏者，故小手距之鋼琴彈奏者會使用較為外展的手指角度來代償固定之琴鍵距離，以彈奏出和絃及八度音技巧。研究結果亦顯示小手距者於彈奏和絃技巧樂曲時，其右手食指、右手無名指、左手拇指、左手食指及左手無名指的手指外展角度使用百分比皆超過百分之百，此結果同樣呈現於彈奏八度音技巧樂曲時之右手拇指、右手食指、右手無名指、右手小指、左手拇指、左手食指、左手無名指及左手小指，故可推論小手距者在彈奏和絃及八度音技巧樂曲的動作過程中，各指間的外展角度會大於其本身所認知可以撐到之最大指間外展角度，此動態表現往往超過其本身最大手指外展角度的負荷及限制，也就是手指會過度的外展以彈奏和絃及八度音技巧；反觀大手距者於彈奏此技巧樂曲時，其外展角度使用百分比皆小於百分之百，可推論大手距者較不需使用超過本身靜態最大之外展角度以彈奏和絃及八度音。故此推論小手距者比起大手距者，會因需在彈奏當下極短的時間內要求手部之外展及內在肌群完成遠比認知更大之肌肉收縮，方能以過度外展來完成彈奏和絃及八度音技巧，此舉對於平日較易忽略柔軟度及肌力訓練的手部肌肉上，確實易產生相關傷害或疼痛。Deahl 與 Wristen (2003) 亦提出小手距之鋼琴彈奏者彈奏和絃及八度音技巧需撐大其手指外展角度，因此易產生肌腱炎或其他手部傷害。Sakai 等人 (2006) 的研究結果指出，小手距之鋼琴彈奏者於彈奏和絃及八度音技巧時，其拇指的外展角度顯著大於大手距之鋼琴演奏者，此研究推論過度外展的拇指動作，在反覆且長時間的練習及使用下，易導致外展拇長肌 (abductor pollicis longus) 用力過度及

摩擦，而導致媽媽手。本研究除運用客觀運動學分析呼應上述研究所提出之論點外，更指出除了拇指之外，包括食指、無名指及小指，於彈奏過程中亦會出現較大或過度的外展角度動作，故推論當以較大或過度的手指外展角度以彈奏和絃及八度音技巧時，除了Sakai研究中所提出的外展拇長肌外 (Sakai et al., 2006)，各指背側骨間肌 (dorsal interossei muscles) 及外展小指肌 (abductor digiti minimi) 等，也會因反覆地彈奏和絃及八度音技巧，而使得這些肌肉及肌腱重複及過度地用力，而有手背疼痛甚至傷害的現象產生。故依此可推論小手距之鋼琴彈奏者有較高手部疼痛或傷害的發生率，加上需長時間以過度外展的手指動作練習相關技巧，易好發之手部傷害包括媽媽手 (Lee, Hanks, & Schwartz, 2005; Sakai, 1992, 2002; Sakai et al., 2006)、骨間肌疼痛及外展小指肌疼痛 (Sakai, 1992, 2002)。

本研究結果同時發現所有受測者於彈奏和絃及八度音技巧樂曲時，其手部外展角度使用百分比皆大於50%，有的手指甚至大於100%，顯示此兩種演奏技巧皆需較大的手指外展角度來彈奏，推論彈奏或反覆練習和絃與八度音此兩種技巧，容易導致傷害的產生，此結果呼應了早期的研究，指出彈奏和絃及八度音兩種技巧時，因需以較為外展的手指角度彈奏鋼琴，故相關手部疼痛及傷害的危險率亦較高 (Sakai, 1992, 2002; Sakai et al., 1996; Sakai et al., 2006; Shields & Dockrell, 2000)。

二、手距大小對指關節之屈曲伸展活動度差異性探討

彈奏鋼琴的過程中，手部的動作包括矢狀切面、冠狀面及橫切面此三個解剖平面之動作。本研究除了從冠狀面探討大手距與小手距兩組之手指外展角度差異外，亦從矢狀切面來探討兩組鋼琴演奏者於彈奏和絃及八度音時，其指關節屈曲伸展活動度之表現及差異。

Hume、Gellman、McKellop 與 Brumfield (1990) 使用電子量角器量測手指關節於執行日常生活活動之功能性屈曲伸展活動度範圍，拇指指關節為2度至43度、掌指關節為10度至32度，手部其餘四指之功能性屈曲伸展活動度範圍為遠端指關節20度至61度、近端指關節36度至86度及掌指關節33度至73度。本研究結果

中，彈奏和絃樂曲時，拇指指關節之屈曲伸展活動度範圍為22度至37度，掌指關節為17度至45度；彈奏八度音樂曲時，拇指指關節之屈曲伸展活動度範圍為20度至25度，掌指關節為13度至19度，故拇指關節於彈奏兩首樂曲之屈曲伸展活動度皆維持於其功能性屈曲伸展活動度範圍內，但掌指關節於彈奏和絃時會有大於功能性屈曲伸展活動度的角度範圍出現。其餘四指於彈奏和絃樂曲時，遠端指關節之屈曲伸展活動度範圍為17度至43度、近端指關節18度至52度及掌指關節19度至57度；彈奏八度音樂曲時，遠端指關節之屈曲伸展活動度範圍為5度至20度、近端指關節9度至22度及掌指關節17度至35度，故食指、中指、無名指及小指於彈奏兩首樂曲時，其三個指關節之屈曲伸展活動度範圍皆維持或小於指關節功能性的屈曲伸展活動度範圍內，因此推論指關節於彈奏和絃及八度音樂曲時較無過度屈曲或伸展的動作產生。

本研究結果中，彈奏和絃技巧樂曲時，拇指指關節於動作過程中之屈曲伸展活動度比起掌指關節及腕掌關節為大，故拇指於彈奏和絃樂曲中，以指關節屈曲伸展活動度最大；腕掌關節屈曲伸展活動度最小。其餘四指，主要以掌指關節之屈曲伸展活動度較大。彈奏八度音技巧樂曲時，拇指仍以指關節屈曲伸展活動度最大；腕掌關節屈曲伸展活動度最小。其餘四指，仍以掌指關節之屈曲伸展活動度較大。

此外，彈奏和絃時各手指指關節之屈曲伸展活動度比起彈奏八度音大且屈曲伸展活動度較為平均，故和絃技巧主要以五隻手指各指關節持續的屈曲伸展動作來彈奏；八度音因只需使用拇指及小指彈奏，故拇指與小指之屈曲伸展活動度，比起食指、中指及無名指之活動度來得大，此角度差異尤其以遠端指關節 (指關節) 更是明顯，推論與八度音需手指外展彈奏相關，故鋼琴演奏者在外展的手指姿勢下，會以拇指及小指的遠端指關節 (指關節) 之屈曲伸展動作彈奏琴鍵為主。

大手距與小手距兩組鋼琴彈奏者，在雙手各指關節之屈曲伸展活動度並無達到顯著的差異結果，先前文獻曾有從矢狀切面以探討彈奏鋼琴之手部動作，但其研究主題主要為單純地探討特殊鋼琴技巧的動作表現，Sakai 等人 (1996) 提出彈奏音階時，手部動作維持於掌指關節屈曲及近端指關節伸展以彈奏鋼琴；彈奏和絃時，以重複的手腕關節屈曲動作為主。Wristen (2000) 從生物力學觀點，使用觀

察彈奏鋼琴方法，以質性方法描述彈奏特殊技巧時之手部動作表現，提出彈奏八度音技巧時的手部動作，包括手腕高於前臂，且持續維持於尺側彎曲，手部的弓 (arch) 因手指頭為外展動作，故為平坦的；彈奏和絃樂曲時，手腕會以向外側微調的動作及彈奏過程中手指接近於琴鍵表面。

先前並未有研究針對手距大小，比較其指關節於矢狀切面動作之表現差異，本研究結果提出大手距與小手距兩組鋼琴彈奏者於彈奏和絃及八度音技巧時，由矢狀切面之指關節屈曲伸展動作所帶來之傷害影響較不顯著，主要仍以手指外展角度動作所引起的傷害為主，雖早期流行病學的研究指出屈肌腱鞘滑膜炎亦為常見與演奏相關之肌肉骨骼傷害，其成因可能是因重覆持續地作屈曲伸展的動作所致，然本研究並未能將此長時間重覆表現的因子呈現，未來的研究可以對此議題深入探討之。

三、左右手指關節之屈曲伸展動作單元差異性探討

本研究結果得知，彈奏雙手旋律一致之和絃及八度音技巧時，右手之指關節屈曲伸展動作單元顯著多於左手，推論彈奏鋼琴之動作過程中，右手普遍會出現較多加速減速的動作過程，故推論右手因平常練習時，以彈奏主旋律為主，故即使於雙手皆彈奏相同旋律時，其右手仍有較多不自主預備彈奏動作的產生。局部肌張力異常 (focal dystonia) 為作家、打字者及音樂演奏者常見的職業傷害，為一項與操作事務 (task-specific) 相關的動作疾患，目前引起的原因尚不清楚，主要是指在自主的動作過程中，出現一些不自主的肌肉收縮現象，常見於鋼琴彈奏中的異常動作表現包括單獨手指不自主的屈曲動作，尤其以右手最為常見 (Bejjani et al., 1996; Jabusch, Vauth, & Altenmueller, 2004; Lederman, 2003; Lim & Altenmuller, 2003; Sakai et al., 2006)。故鋼琴彈奏者於彈奏和絃及八度音樂曲時，右手出現較多不自主的預備彈奏動作，加上長期且反覆的練習，推論較多不自主的動作易導致局部肌張力異常或其他重覆累積性傷害的產生，此研究結果並呼應文獻中所提肌張力異常或其他與演奏相關之肌肉骨骼傷害常好發於右手此論點 (Chung et al., 1992; Dawson, 2005; Goodman & Staz, 1989; Jabusch et al., 2004; Lederman, 2003; Pak & Chesky, 2001)。

四、職能治療臨床運用與人因工學建議

目前台灣音樂界與復健醫療領域之連結尚未建立，本研究以鋼琴彈奏者此一人數不少之職能團體為起始點，擬從研究過程中建立起職能治療專業與音樂演奏者間之橋樑，因彈奏鋼琴所需學習之派別及技巧眾多，也因個人的學習與練習之差異性大，突顯早期的預防及疼痛的發現，比後期之治療重要，故從彈奏鋼琴之生物力學表現中以推論相關危險因子及所連結之傷害，可提供鋼琴演奏者有效之預防策略及保護策略。

本研究提出小手距為導致傷害產生的危險因子之一，亦提出了右手於彈奏鋼琴時，會出現較多不自主的預備彈奏動作表現等，提供鋼琴彈奏者及醫療人員了解此危險因子與動作表現的影響，此外依生物力學表現推論可能導致之傷害，如媽媽手、骨間肌疼痛、外展小指肌疼痛、腕隧道症候群、局部肌張力異常等，藉此可協助臨床治療者於診斷確立之餘，回推傷害產生之原因，如彈奏和絃及八度音技巧易使得小手距之鋼琴彈奏者出現手指過度外展之現象，而非只是建議鋼琴演奏者減少彈奏或練習鋼琴的時間，臨床治療者可依解剖構造及生物力學觀點，更精確地提供相關之預防及治療策略，如此可強化醫療領域與音樂界之連結。

職能治療師亦可依據研究所得之結果，了解手部肌肉之特性及彈奏過程中之需求，以教導鋼琴彈奏者相關預防傷害的策略，包括彈奏鋼琴前之暖身活動確實地執行，暖身活動宜為緩慢平順的柔軟度訓練，尤其以手指及手腕之拉筋更是重要 (Goodman & Staz, 1989)。除了預防策略外，治療師亦須教育鋼琴彈奏者伸展及強化手部外展肌群及內在肌群，如重覆向外拉開有阻力的彈簧球等。此外，長時間的練習下，中間適度的分段休息也是必要的，可緩和持續彈奏過程中，手指關節及肌腱的負擔。建議鋼琴彈奏者適時地減少及分配日常生活中需重覆手指動作之活動，如打電腦，長時間使用電腦亦會導致相關手部傷害的產生 (Bergquist, Wolgast, Nilsson, & Voss, 1995; Gerr et al., 2002)。

另從人因工程的觀點，目前鋼琴皆為單一標準化鋼琴 (one-size-fits-all) (Deahl & Wristen, 2003)，小手距之鋼琴彈奏者其手指於彈奏鋼琴時會有過度且超過本身限制之外展角度，導致其在此不佳的工作空間設計中，會產生不舒適且工作效率

不佳等結果產生，目前相關之鋼琴製造商於訂製鋼琴時，並未將相關人體計測因子或是解剖概念等加入鋼琴的工作環境設計中，如同大提琴之設計有大小之分，可適合不同身高及體型之演奏者，本研究團隊期許未來可提供製造商更多實證之數據，如針對大手距的鋼琴彈奏者可練習彈奏一般之單一標準化鋼琴，但小手距之彈奏者可設計出縮小琴鍵寬度之鋼琴供其練習，如此可降低不良且易產生傷害的工作環境風險。

五、本研究限制及未來研究建議

目前研究仍缺乏探討鋼琴彈奏者之手指關節、肌腱、韌帶及肌肉的受力情形與用力策略，是如何影響肌肉骨骼疼痛產生 (Harding, Brandt, & Hillberry, 1989)，故鋼琴彈奏時，除了運動學表現，相關之手部力學探討也是極為重要的。此外，本研究因環境及設備之限制，故所採用之研究設備為數位鋼琴，但大多數鋼琴演奏者平時練習之鋼琴仍以傳統直立式鋼琴為主，故未來研究建議可使用直立式鋼琴以量測鋼琴演奏者相關之生物力學表現。再者，於研究結果中發現有受測者間的差異性存在，故未來持續研究建議可增加樣本數，如此可以增加研究之檢力，降低結果的差異性。

本研究所指定之樂曲為和絃及八度音，不同的技巧其手指彈奏之動作策略與表現亦不同，故本研究結果所探討與危險因子相關之傷害，僅能推論為彈奏和絃及八度音技巧相關傷害容易產生，無法將結果延伸至所有小手距的鋼琴演奏者，故未來研究可延續，加入分析其他鋼琴技巧，包括震音 (trills)、琶音 (arpeggios) 等。此外，鋼琴此專業各學派對於彈奏技巧的訓練方式不同，故受測者可能因學習過程不同而有不同的表現，此論點需詳細考量於未來的研究中。

關於彈奏鋼琴之傷害預防策略很重要的一環即為--教育。許多鋼琴教師於指導學生彈奏樂曲之技巧時，大多皆僅限於經驗分享，如彈奏時手部的最佳姿勢位置擺放或調整，較缺乏科學化研究證據加以指導 (Sakai et al., 1996)。本團隊期望未來可採用客觀且更為精進之生物力學研究，量化出更多與彈奏相關的實證依據，做為未來在音樂教育之訓練過程中 (無論是音樂班或音樂系之常規課程，或

是自幼學習樂器之課程)，可教導老師或學生以正確的手部姿勢維持或適當的出力以彈奏樂曲，以防傷害之產生。

結論

彈奏鋼琴為密集使用手指動作之活動 (hand-intensive activity)，導致鋼琴彈奏者患有與演奏相關之肌肉骨骼疼痛或疾病的危險因子很多，在重複練習及彈奏之下，潛藏著許多鋼琴彈奏者本身生理上的需求或限制，本研究僅從運動學及人因之觀點，探討鋼琴彈奏者手距大小或左右手之表現差異及連結至相關的臨床傷害，本研究結果支持小手距為導致傷害之危險因子之一，且右手的動作表徵較易引起傷害的產生，但彈奏鋼琴仍包含很多因子尚未在本研究做考量，未來還需有更多研究來深入探究此議題。

誌謝

本研究由國科會NSC 95-2221- E-006-242-MY3計畫經費補助執行，特此感謝。

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表4
手距大小於彈奏和絃時，各指關節之屈曲伸展活動度差異

F/E ROM_Chord	DIP (IP) joint			PIP (MCP) joint			MCP (CMC) joint		
	平均值(標準差)		p	平均值(標準差)		p	平均值(標準差)		p
	大手($n = 8$)	小手($n = 8$)		大手($n = 8$)	小手($n = 8$)		大手($n = 8$)	小手($n = 8$)	
R_thumb (degree)	21.4 (6.5)	24.0 (6.9)	.462	16.5 (4.7)	17.8 (8.8)	.916	13.9 (7.2)	14.3 (5.9)	.834
R_index finger (degree)	18.1 (9.6)	14.7 (7.5)	.401	22.0 (9.5)	22.8 (12.7)	.834	29.9 (7.6)	25.8 (7.4)	.248
R_middle finger (degree)	24.3 (11.3)	21.2 (5.5)	.916	25.3 (12.4)	30.1 (9.1)	.345	32.4 (4.1)	31.4 (9.5)	.674
R_ring finger (degree)	19.0 (6.3)	19.4 (5.6)	1.000	23.5 (11.1)	27.8 (11.5)	.462	19.7 (7.6)	19.7 (3.2)	.600
R_little finger (degree)	18.4 (5.2)	19.4 (9.1)	.834	20.0 (8.5)	17.8 (6.7)	.600	19.2 (7.2)	20.5 (5.6)	.248
L_thumb (degree)	34.0 (11.8)	35.9 (8.3)	.600	31.1 (7.7)	40.6 (15.2)	.172	30.3 (13.7)	36.7 (9.5)	.248
L_index finger (degree)	28.0 (5.9)	27.4 (8.8)	.753	37.7 (10.8)	41.9 (12.1)	.674	45.4 (13.0)	49.5 (10.7)	.462
L_middle finger (degree)	36.2 (7.3)	35.1 (9.8)	.674	33.4 (12.5)	41.2 (10.7)	.172	45.1 (7.1)	51.9 (12.3)	.208
L_ring finger (degree)	30.2 (5.4)	30.7 (7.0)	.916	43.4 (8.3)	44.0 (14.7)	.834	51.4 (10.3)	60.0 (22.0)	.529
L_little finger (degree)	41.5 (16.7)	35.3 (13.7)	.345	47.4 (17.8)	46.7 (15.8)	.753	39.1 (10.9)	46.7 (16.9)	.462

註： DIP (IP) joint表示拇指之指關節，食指、中指、無名指及小指之遠端指關節。
PIP (MCP) joint表示拇指之掌指關節，食指、中指、無名指及小指之近端指關節。
MCP (CMC) joint表示拇指之腕掌關節，食指、中指、無名指及小指之掌指關節。
相關考驗 $p < .05$ 的顯著水準（雙側）。

表5
手距大小於彈奏八度音時，各指關節之屈曲伸展活動度差異

F/E ROM_Octave	DIP (IP) joint			PIP (MCP) joint			MCP (CMC) joint		
	平均值(標準差)		p	平均值(標準差)		p	平均值(標準差)		p
	大手($n = 8$)	小手($n = 8$)		大手($n = 8$)	小手($n = 8$)		大手($n = 8$)	小手($n = 8$)	
R_thumb (degree)	22.8 (5.7)	21.4 (6.5)	.674	17.2 (6.6)	12.0 (5.2)	.046*	14.7 (7.1)	15.7 (8.7)	1.000
R_index finger (degree)	6.7 (3.7)	6.5 (5.8)	.529	14.3 (6.5)	9.6 (5.1)	.208	25.3 (11.3)	23.9 (10.3)	.834
R_middle finger (degree)	11.0 (5.2)	5.6 (2.4)	.016*	17.4 (8.4)	9.8 (2.2)	.036*	18.3 (4.0)	24.2 (8.3)	.172
R_ring finger (degree)	11.4 (4.6)	10.0 (5.5)	.674	17.1 (6.1)	16.6 (6.8)	1.000	19.5 (7.1)	19.2 (5.1)	.753
R_little finger (degree)	20.2 (5.4)	19.0 (7.0)	.916	17.9 (8.0)	16.7 (9.9)	.674	21.3 (8.5)	27.3 (12.8)	.401
L_thumb (degree)	26.0 (8.5)	22.1 (6.7)	.529	19.4 (7.5)	18.1 (9.1)	.600	19.3 (6.7)	18.5 (8.5)	.753
L_index finger (degree)	8.0 (5.9)	6.0 (3.7)	.529	13.3 (5.2)	15.7 (6.1)	.462	26.5 (9.8)	35.9 (11.8)	.074
L_middle finger (degree)	13.3 (8.9)	8.0 (5.1)	.208	20.2 (8.5)	17.8 (4.9)	.834	23.4 (8.9)	36.4 (10.9)	.016*
L_ring finger (degree)	19.0 (17.0)	9.4 (3.8)	.294	21.1 (4.4)	22.0 (7.8)	.753	20.8 (5.9)	29.7 (9.1)	.059
L_little finger (degree)	20.4 (9.5)	14.6 (6.4)	.294	15.6 (7.3)	11.6 (5.0)	.345	28.7 (14.1)	33.2 (11.1)	.294

註： DIP (IP) joint表示拇指之指關節，食指、中指、無名指及小指之遠端指關節。
PIP (MCP) joint表示拇指之掌指關節，食指、中指、無名指及小指之近端指關節。
MCP (CMC) joint表示拇指之腕掌關節，食指、中指、無名指及小指之掌指關節。
相關考驗 $^{*}p < .05$ 的顯著水準（雙側）。

表6
左右手於雙手旋律一致之和絃，各指關節之屈曲伸展動作單元比較

MU_Chord_bi	DIP (IP) joint			PIP (MCP) joint			MCP (CMC) joint		
	平均值（標準差）		p	平均值（標準差）		p	平均值（標準差）		p
	左手(n = 16)	右手(n = 16)		左手(n = 16)	右手(n = 16)		左手(n = 16)	右手(n = 16)	
Thumb	75.8 (6.5)	80.1 (6.3)	.004**	73.9 (5.5)	77.6 (6.3)	.001**	72.6 (5.8)	76.1 (6.4)	.001**
Index finger	74.8 (6.1)	78.3 (5.4)	.001**	73.2 (5.9)	75.9 (6.0)	.001**	73.2 (6.2)	76.9 (5.9)	.001**
Middle finger	73.7 (4.9)	77.9 (5.9)	.001**	72.7 (6.5)	76.3 (5.3)	.001**	73.3 (6.0)	76.3 (6.3)	.001**
Ring finger	73.6 (6.7)	77.8 (5.3)	.003**	72.8 (6.1)	76.7 (5.9)	.001**	73.1 (6.4)	77.4 (6.4)	.001**
Little finger	74.6 (5.5)	80.0 (7.9)	.001**	75.1 (4.9)	77.4 (4.8)	.006**	73.7 (5.2)	76.9 (5.5)	.002**

註： DIP (IP) joint表示拇指之指關節，食指、中指、無名指及小指之遠端指關節。
PIP (MCP) joint表示拇指之掌指關節，食指、中指、無名指及小指之近端指關節。
MCP (CMC) joint表示拇指之腕掌關節，食指、中指、無名指及小指之掌指關節。
相關考驗 $^{**}p < .01$ 的顯著水準（雙側）。

表7

左右手於八度音，各指關節之屈曲伸展動作單元比較

MU_Octave	DIP (IP) joint			PIP (MCP) joint			MCP (CMC) joint		
	平均值（標準差）		p	平均值（標準差）		p	平均值（標準差）		p
	左手(n = 16)	右手(n = 16)		左手(n = 16)	右手(n = 16)		左手(n = 16)	右手(n = 16)	
Thumb	37.3 (3.0)	41.2 (1.8)	.001**	35.8 (3.8)	39.7 (2.0)	.001**	35.2 (2.5)	40.6 (1.9)	.000**
Index Finger	40.1 (3.6)	43.1 (3.3)	.006**	36.5 (2.6)	40.6 (3.6)	.001**	35.7 (4.2)	40.1 (3.1)	.001**
Middle Finger	38.3 (3.5)	42.8 (3.3)	.001**	35.7 (3.7)	41.3 (3.1)	.000**	34.7 (2.7)	40.3 (3.0)	.000**
Ring Finger	38.8 (3.6)	42.2 (4.0)	.018*	36.1 (2.4)	39.5 (3.2)	.001**	35.2 (2.5)	40.0 (3.4)	.001**
Little Finger	39.0 (2.9)	41.5 (3.5)	.011*	38.3 (2.6)	40.7 (2.6)	.005**	36.4 (2.5)	42.1 (2.1)	.000**

註： DIP (IP) joint表示拇指之指關節，食指、中指、無名指及小指之遠端指關節。
PIP (MCP) joint表示拇指之掌指關節，食指、中指、無名指及小指之近端指關節。
MCP (CMC) joint表示拇指之腕掌關節，食指、中指、無名指及小指之掌指關節。
相關考驗 $^{*}p < .05$ 的顯著水準（雙側）。
相關考驗 $^{**}p < .01$ 的顯著水準（雙側）。

Journal of Taiwan Occupational Therapy Association
2012, 30(1), 7-33

Original article

Investigation of the Injured Mechanism of the Hand During Piano Playing Based on Ergonomic and Kinematic Perspectives

OCCUPATIONAL THERAPY

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Abstract

Current studies regarding playing-related injuries of pianists focus on epidemiologic issues. To understand the injury mechanism associated with pianists, this study attempted to investigate kinematic performances of hand during piano playing under different perspectives in ergonomics (hand span and right/left hands) and playing-skills (chord and an octave). Sixteen female pianists passed through the hand span screening were recruited and requested to play the assigned techniques. The kinematic parameters, such as the ratio of maximal digit-to-digit abduction angle, the flexion-extension (F/E) range-of-motion (ROM) of finger joint, and the movement unit of F/E of each finger joint were obtained via the motion capture system and custom programs. The results showed significant difference of the ratio of maximal digit-to-digit abduction angle between large and small hand span pianists while playing both chord and octave. The F/E ROM of finger did not show significant difference between these two groups when playing the techniques. The movement unit of F/E of each finger joint of the right hand was significantly larger than the left hand. The small hand span pianists use wider finger abduction to play the chord and octave. In addition, the right hand presented more movement units than the left hand did so that it indicated the right hand have more chances of the unconscious movement to prepare for the playing performances. This study concluded that the small hand span and the right hand side might be the risk factors to result in some playing-related injuries of the hand.

Keywords: *Pianist, Ergonomics, Kinematics, Hand injury*

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Received: 24 December 2011
Accepted: 4 March 2012

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職能治療學會雜誌
民國 101 年 30 卷第 1 期頁 34-52

中風個案與家屬對職能治療之認識程度初探

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摘要

職能治療知識 (occupational therapy knowledge, OTK) 為與職能治療 (occupational therapy, OT) 相關且對個案與家屬重要的知識。OTK不足可能使個案與家屬誤解OT，降低治療順從度與OT效能。然而目前無法確定中風個案與家屬的OTK程度與影響因子。本研究之主要目的為探討中風個案與家屬之OTK程度及影響因子。次要目的為探討中風個案與家屬所需之OTK內容及偏好之資訊傳遞方式。參與者為接受OT的中風個案或家屬，且接受二次OTK問卷訪問（第一次為問答題，結果代表OTK之低估值。第二次為提供選項之多選題，分數代表OTK之高估值），可能得分範圍皆為0-13分。其次，比較不同人口學特性之受訪者二次訪談之平均是否有顯著差異，並計算受訪者年齡、個案中風後時間與OTK程度的相關程度。最後，將受訪者所需之OTK內容與偏好之資訊傳遞方式的選項加權排序。51位受訪者（29位個案）二次訪問之平均OTK分數為 6.8分。受訪者的OTK程度僅與其身份（個案或家屬）有顯著關聯 (p = .025)。受訪者自覺最需要之OTK為OT治療目標，最偏好之資訊傳遞方式為一對一口頭說明。本研究發現中風個案與家屬之OTK程度普遍偏低，而且與教育程度及接受OT的時間長短無關。未來宜以一對一口頭說明的方式加強說明治療目標，以期提高個案及家屬之OTK程度，進而提升治療順從度與OT效能。

關鍵字：職能治療知識，中風，問卷，順從度

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受文日期：民國100年10月11日
接受刊載：民國100年12月27日

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前言

中風病患為職能治療 (occupational therapy, OT) 主要服務的對象之一，中風病患家屬由於常陪同中風病患參與治療、協助病患執行居家治療活動 (home program) 與日常生活照顧，也是重要的醫療決策者之一 (Lawrence, Kerr, Watson, Paton, & Ellis, 2010; Ottenbacher et al., 2001)。研究指出：病患與家屬對醫療專業的理解程度對治療順從度有很大的影響 (Bhavnani, Fisher, Winfield, & Seed, 2011; De Maria, Lussier, & Bajcar, 2011)。因此，中風病患與家屬對OT的瞭解（OT知識[OT knowledge, OTK]）可能影響他們對OT的順從度。

本研究定義OTK的概念為：與OT相關，且對病患及家屬重要的OT資訊。例如：OT的服務內容、治療媒介、服務對象、取得OT服務的管道、與其他醫療專業的區別等 (Maitra & Erway, 2006)。若接受OT服務的中風病患與家屬未能具備充足的OTK，短期內可能造成三個不良影響：一、對OT有錯誤的認識或期待。例如：病患不知道OT運用日常活動器材之目的而認為OT是在玩小孩活動、或是只要持續做OT，終能痊癒。病患與家屬上述錯誤的認識與期待會降低他們對OT的信任，也影響治療參與度 (Wilding & Whiteford, 2007)。二、不知提出那些適當的需求。例如：居家改造評估、輔具購買評估與補助等。當病患中風時，病患與家屬通常不知道要準備那些物品、可以申請那些補助、如何幫助家人恢復健康、以及應該向誰提出相關問題（甚至不知從何問起）。因此可能延遲他們調適心情、積極面對中風後復健的時間，也錯過治療相關訊息 (Mackey, 2007)。三、不知如何取得OT服務。例如：不知道除了醫院以外還有那些地方可以接受OT服務，因此無法就近取得資源，例如：社區OT、長期照護機構等。病患集中在醫院，除了降低醫院的服務品質（治療師同一時段要服務多位病人），也不利於醫院體系外的OT發展。長期而言，病患與家屬如果OTK程度不足，將不利於病患之功能恢復，降低OT效能。

先前研究顯示一般民眾對OT所知甚少，甚至誤解（毛慧芬、謝清麟，民89；謝清麟、毛慧芬，民 83）。目前並無研究探討中風病患與家屬的OTK程度，亦不確定影響OTK程度的因子，以及中風病患與家屬自覺所需的OTK項目。因

此造成職能治療人員難以掌握需要加強OTK的族群，並提供病患與家屬所需的OTK。故本研究之主要目的為初步探討中風病患與家屬對OTK之認識程度，並探索影響OTK程度之因子，次要目的為探討中風病患與家屬需要之OTK內容及偏好的OTK資訊傳遞方式。

研究方法

一、 研究對象

本研究的病患來自中部一家教學醫院之中風病患與家屬。收案標準為：(一)、經醫師診斷為中風之病患或病患家屬。(二)、可以閱讀中文、聽懂國語，並且可以用國語或台語清楚表達自己的想法。(三)、受訪前一個月內曾接受過OT服務。(四)、瞭解研究內容並同意參與。排除標準為：(一)、由於失語症或認知障礙而影響作答者。(二)、負責該名病患的治療師認為病患無法清楚表達或理解問卷內容。(三)、定向感（包括人物、空間、時間定向感）與數字減法（100-7連續減3次）的認知篩選測驗，無法完全答對者。(四)、受訪者於本研究之訪談前，曾接受過其他與OTK相關之研究訪談。

若病患與家屬皆符合收案條件，且願意接受訪談，則優先邀請病患（因為家屬不一定時常陪同病患接受OT，家屬的需求可能與病患不相同）。若中風病患受限於認知障礙（排除條件1-3），則訪問一位陪同病患接受OT，而且認知功能正常的家屬。一個家庭以訪問一位成員為限，以免訪談結果過於相近。

二、 研究流程

本研究經由倫理試驗委員會核准，於中部一家教學醫院收案。本研究由4位受過問卷使用訓練的訪員（3位職能治療系大學生與1位職能治療所碩士生）對中風病患或家屬進行「職能治療知識問卷（OTK問卷）」訪談。4位訪員皆受過3小時的問卷使用、訪談練習與訪談觀摩的訓練。

為確保結果可信，訪談環境、訪談對象皆有特別限制。訪談環境之選擇條件

有二：(一)、在治療室以外看不見治療器材與治療師工作內容的安靜環境，以避免提供受訪者回答的線索。(二)、選擇不會被其他病患或家屬清楚聽到訪談內容的地方。以免影響其他人之訪談結果。訪談對象的限制為一次只訪問一位病患或家屬，避免家屬與病患同時回答，混淆訪談結果。若受訪者身邊有其他人陪同，須先向其他人說明訪談時，請他們暫勿表達意見。

三、工具

(一)、問卷設計

本研究以OTK問卷進行訪談。OTK問卷之內容發展，先由3位職能治療師（2位資深生理OT學校教師與1位資深臨床生理職能治療師）參考毛慧芬、謝清麟發展之相關問卷（毛慧芬、謝清麟，民 89；謝清麟、毛慧芬，民 83），討論出7個對病患或家屬重要的OTK項目（OT的養成教育、服務項目、治療媒介、服務對象、服務場所、與其他專業之區別），及3個與OTK程度無關，但可作為後續職能治療師提供OTK之參考的項目（得知OT的管道、對OTK的需求以及偏好之資訊傳遞方式）。因此OTK問卷共包含10個項目。研究者依據此10個項目撰寫題目之後，再邀請上述3位職能治療師確認問卷內容是否涵蓋OTK問卷所欲評估的特質，以建立項目之內容效度 (content validity) (Feeney-Kettler, Kratochwill, & Kettler, 2011; Landers, Durand, Powell, Dibble, & Young, 2011)。

而後，以一對一認知訪談 (cognitive interview) 訪問30位來自台北一家教學醫院的中風病患或家屬，修改題目並確定OTK問卷之可讀性與表面效度 (face validity) (Christodoulou, Junghaenel, DeWalt, Rothrock, & Stone, 2008; Irwin, Varni, Yeatts, & DeWalt, 2009)。認知訪談由2位瞭解OTK問卷架構的訪員執行認知訪談。訪員先依據原本的問卷題目訪談病患或家屬，再於填答完問卷後，向受訪者確認問卷的文字是否明確清楚、受訪者所理解的題意與題目所欲測量的概念是否相同（由訪員詢問受訪者「請問您認為這個題目主要是在詢問什麼？請問您在回答這題的時候想到甚麼？為什麼會選這個答案？」研究者再依據訪員的紀錄，判斷受訪者對題目的理解與題目所欲測量概念是否相符）、有無修改建議等。

研究者除了依據訪談結果修改問卷，也加入受訪者常回答的內容作為題目選項，以便後續訪談時，記錄訪談結果。當所有題目都被10位受訪者測試且完成認知訪談後，則完成一次認知訪談。研究者即依據認知訪談過程中，受訪者的建議修改問卷。問卷修改後即進行下一次認知訪談，以確保修改得當。本研究預計進行三次認知訪談。若受訪者沒有進一步的修改建議，則完成表面效度之確認。

（二）、OTK問卷內容

OTK問卷含二部分：OTK訪談項目與受訪者基本資料。前者為10題與OT相關的簡答題（第2-8題的內容依序為OT養成教育、服務項目、治療媒介、服務對象、服務場所、掛號科別與治療次數、專業區別。上述7題可反映受訪者的OTK程度，第1、9、10題的內容為獲得OT訊息的管道與原因、知識需求與宣傳媒介。上述3題可作為後續職能治療師提供OTK的參考）。後者為受訪者基本人口學資料，例如：性別、年齡、教育程度、中風後時間長度等。問卷內容詳附錄1。

OTK問卷須在一次訪談中訪談同一份問卷二次，以瞭解受訪者在作答線索多寡不同的情況下，所表現出的OTK程度。第一次為不提供選項之簡答題，第二次則提供放大版（一頁只包含一個問題，所有字體大小皆為20號字）的題目與選項供受訪者參考作答。

（三）、OTK問卷之計分方式

與OTK程度相關的7題（第2-8題）中，有標準答案的題目共有3題：第2題（養成教育）、第6題（服務場所）與第7.(2)題（治療次數）。每答對一題得1分，答錯得0分。無固定標準答案的題目（受訪者可能因為自身經驗而選擇不同答案的題目）：第3（服務項目）、4（治療媒介）、5（服務對象）、7.(1)（掛號科別）、8題（專業區別）為0-1-2計分。若能說出或選出所有適當的選項，而且沒有選出不適當的選項，得2分。可選出1個以上的適當選項，但沒有選出所有適當的選項，或是選出部分適當、部分不適當的選項，得1分。完全未選出適當答案，則得0分。評分標準詳見附錄2。

由於有標準答案的題目較為簡單，因此每題以1分計。無固定標準答案的題

目較為困難，因此研究者設計部分得分（若受訪者可答對某題一部分的內容，則可得到這題一部份的分數。詳細計分方式為：0表示完全答錯，1表示有些答對，有些答錯，2表示完全答對）。例如：請受訪者說出「職能治療師常用的治療器材或工具，越多越好」，若受訪者無法說出任何治療器材，則得0分。可說出1-5種治療器材得1分。可說出6種以上治療器材得2分。因此題目設計為邀請受訪者盡可能將所知道的治療器材說出，越多越好。

每次訪談的滿分皆為13分。OTK程度以二次訪談的分數平均計算。分數越高，表示程度越好。

四、資料分析

本研究之資料分析分為人口學變項的描述性統計、OTK程度與其他OTK相關資訊之描述性統計與統計檢定。本研究設定所有統計檢定之臨界值皆為 .05。

受訪者之OTK程度以二次訪談分數的平均判斷。本研究將受訪者很可能知道答案的題目（例如：治療媒介、掛號科別）之題目分數加總，以7分為OTK程度的判別標準。低於7分則表示受訪者之OTK不足。

影響OTK程度的因子驗證，先以單變項分析 (univariate analysis) 之。如受訪者之性別、身份（病患本人或家屬）、來源（門診或住院）、教育程度等變項，以獨立樣本雙尾*t*檢定比較不同特性之受訪者OTK程度（二次訪談之平均）是否有顯著差異。另以Pearson's *r*驗證OTK分數與年齡、病患中風後的時間（月數）等變項之關聯程度。以變異數分析 (analysis of variance, ANOVA) 比較各個接受OT時間長度的受訪者之OTK差異。若受訪者之特性變項與OTK分數呈現顯著關聯，則以複迴歸 (multiple regression) 控制該變項之影響後，再分析其它特性與OTK程度之關聯是否顯著。

可作為後續職能治療師提供OTK之參考的3題（得知OT的管道、知識需求、偏好之資訊傳遞媒介），得知OT的管道為加總各項目被選出的次數。次數越多表示受訪者越常由此管道得知OT。知識需求與偏好之資訊傳遞媒介之分析則是加總受訪者所選項目的排名。排名加總數值越大之項目，表示受訪者越喜歡。

第一次訪談時，第9題（知識需求）為簡答題。雖不列入計分，但可看出受訪者在沒有參考資料時，最想知道的OTK為何。

結果

本研究共有51位受訪者參與，其中29位為中風病患，22位為家屬。受訪者平均年齡約51歲。病患多為初次中風，中風後時間分布大，從1個月到13.5年。其他受訪者之人口學資料列於表1。

病患與家屬之第一次訪談平均（分別為5.9與6.6分）略低於研究者設定之標準（7分），第二次訪問平均分數（7.1與7.9分）略高於標準。二次訪談之平均（分別為6.5與7.2分）皆接近標準，而且家屬之OTK程度（二次訪談之平均分數）顯著高於病患 ($p = .025$)。病患與家屬之第二次受訪分數皆顯著高於第一次 ($p < .001$)。二次訪談皆無人滿分，也無人0分。

由於家屬之平均OTK程度顯著高於病患，故研究者以複迴歸控制受訪者身份（病患或家屬）變項對OTK程度造成的影響，再驗證其它各種特性的受訪者之OTK程度發現：不同性別、來源、教育程度（受教育的年數）、接受OT的時間、受訪者年齡、病患中風後時間與OTK得分未達顯著相關 ($p \geqq .337$) (表2)。

其它與OTK相關的資訊部分，80%的受訪者是因為自己或家人生病就醫而得知有OT的存在。10%的受訪者是自己看書、查資料或曾接觸過相關資料而得知。2%的受訪者 (1人) 表示自己並不知道自己正在接受OT（圖 1）。

表1
中風個案與家屬之人口學資料 (*n* = 51)

特性		所有受訪者	病患	家屬
性別	男/女	24/27	19/10	5/17
年齡（歲）	平均±標準差	51.1 ± 12.8	52.5±12.8	49.3±12.8
診斷	腦出血/腦梗塞		12/17	
	腦傷側 左/右		11/18	
受訪者來源	門診/住院	45/6	24/5	21/1
中風次數	中位數（1st-3rd quartile）		1(1-2)	
中風後時間（月數）	中位數（1st-3rd quartile）		20(9-44)	
接受OT的時間	一個月內		1	
	1-3個月		2	
	4-6個月		3	
	6-12個月		4	
	一年以上 （人數）		19	
教育程度	國中以下/高中、高職、專科/大學以上	9/25/17	6/13/10	3/12/7
第一次OTK訪談	平均±標準差（分數範圍）	6.2±1.4 (2-9)	5.9±1.5 (2-9)	6.6±1.2 (5-9)
第二次OTK訪談	平均±標準差（分數範圍）	7.4±1.2 (5-9)	7.1±1.1 (5-9)	7.9±1.1 (5-9)
二次OTK訪談平均	平均±標準差（分數範圍）	6.8±1.2 (4-9)	6.5±1.2 (4-9)	7.2±1.0 (5-9)
二次OTK訪談之分數差距	平均±標準差（分數範圍）	1.3±1.2 (-2-4)	1.2±1.3 (-2-4)	1.3±1.1 (-1-4)

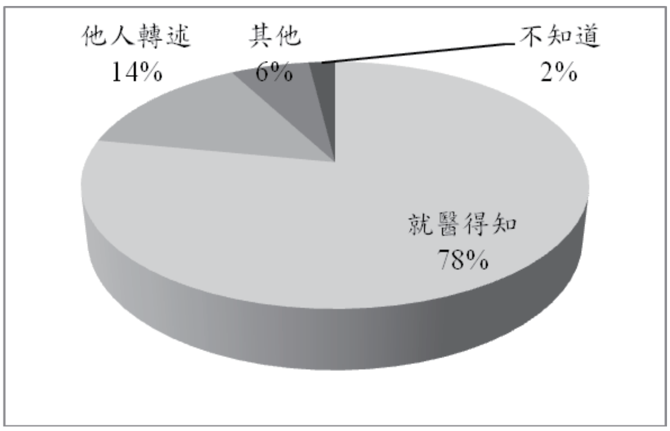

圖1
受訪者獲得OT訊息的管道或原因

表2

各種特性的受訪者之OTK程度比較（*n* = 51）

特性	人數	OTK分數 (Mean ± *SD*)	β 或*t*值[a]	*p*值[b]
性別				
男	24	6.7±1.2	-.04	.787
女	27	6.9±1.1		
來源				
門診	45	6.8±1.1	-.04	.782
住院	6	6.5±1.2		
身份				
病患	29	6.5±1.2	$t = -2.22$	.031
家屬	22	7.2±1.0		
接受OT的時間				
6個月內（基準組）	9	6.4±1.3		
6-12個月	11	6.9±1.4	.09	.631
一年以上	31	6.9±1.0	.16	.384
受教育之年數	51		.03	.836
年齡（年）	51		-.01	.370
中風後時間（月）	51		.14	.305

註：[a] β值為複迴歸（斜率）之係數，*t*值為獨立樣本雙尾*t*檢定之結果。
[b]除了身份變項以外，其餘皆是以複迴歸控制受訪者身份變項後，各變項迴歸係數之*p*值。

圖2為第二次訪談時受訪者最需要的OTK項目，前三個需求為治療目標、治療原理與治療原則（排名加總分別為95、46與41）。有6位受訪者表示不知道自己需要那些OTK項目。與第一次訪談相較，於第一次訪談時，約76%的受訪者表示不知道自己需要那些方面的OTK（例如：OT之服務內容、服務場所及相關補助與法規等）。

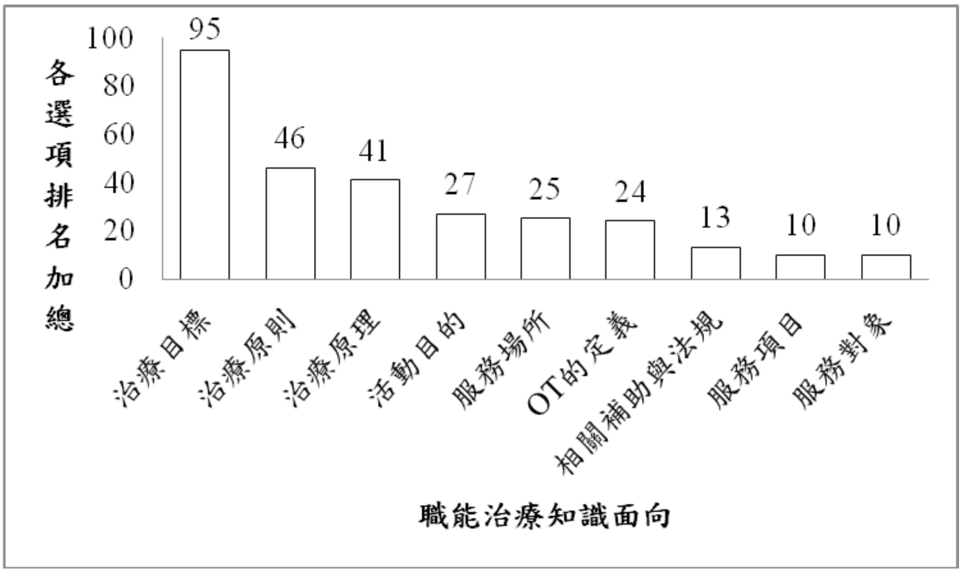

圖2
受訪者所需的職能治療知識項目排序（依據受訪者之喜好加權排列）

圖3呈現受訪者最喜歡的三種資訊傳遞方式依序為：醫療人員一對一口頭說明、衛教手冊與衛教課程（排名加總依序為88、45、34）。

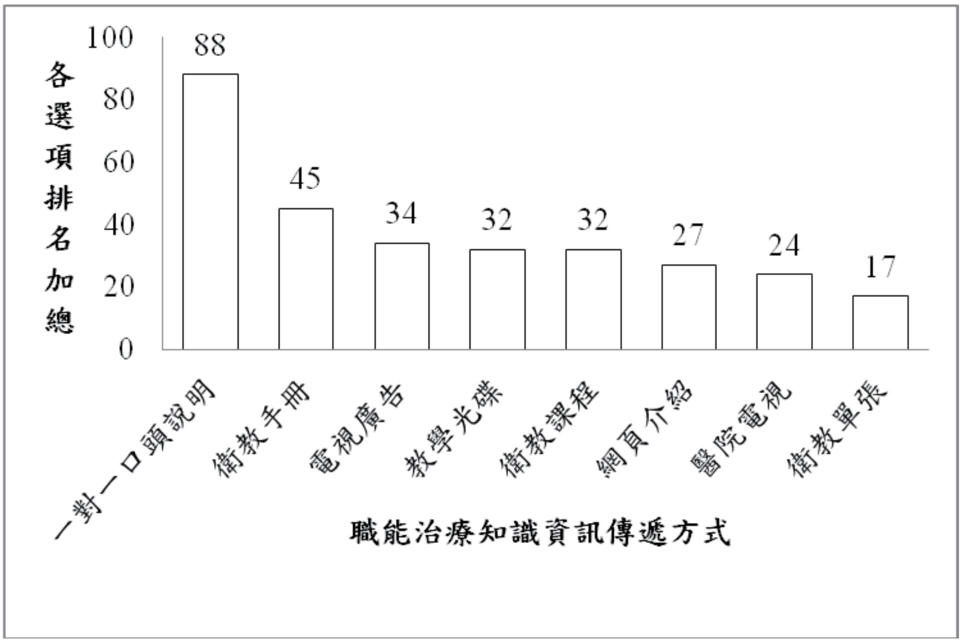

圖3
受訪者偏好的職能治療知識傳遞方式排序（依據受訪者之喜好加權排列）

討論

本研究為首次調查中風病患與家屬之OTK程度，結果發現中風病患與家屬之OTK程度普遍偏低，而且受訪者之OTK程度並未隨著治療時間增加而提升。造成上述現象之原因可能有三個：

一、臨床時間有限：因健保給付的限制，受訪醫院之治療師通常於同一時段須服務多位病患，治療師通常在前幾次治療時說明OT的概念與介紹環境，之後多為提供治療活動與動作指導。由於跟病患與家屬之接觸或溝通時間有限，治療師難以有系統性地向他們介紹OT。

二、病患與家屬未能聽懂或記住治療師的說明：對多數病患與家屬而言，OT為新的概念。於中風住院期間，有許多事情要留意，因此未能充分了解治療師所提供的訊息 (Allison, Evans, Kilbride, & Campbell, 2008)。出院之後的復健，治療師可能曾於治療時精簡地介紹OT，但未能確認病患與家屬之理解情形，且病患與家屬也未積極澄清。

三、OT概念多元，不易理解：OT所提供的服務多元，各學說之治療方式各有異同，可能造成病患與家屬難以從精簡的介紹或觀察其他病友之治療情形理解OT的意義 (Greber, 2011)。

上述第一個原因（時間限制），因為臨床時間為各醫療院所主管依據健保給付制度訂定，病患也多由復健科醫師轉介，職能治療師只能配合規定進行治療，因此治療師難以自行調整臨床治療時間或提供一對一的治療服務。我們若具備有效率的OTK傳遞方式，以快速提升病患之OTK，或可解決此問題。第二、第三個原因（病患與家屬未能完整吸收OTK訊息、OT概念多元）則可能透過發展符合病患與家屬需求的OTK教材，再由職能治療師向病患與家屬說明OT的概念。簡言之，我們亟需發展可快速執行的OTK教材，以便職能治療師於臨床上使用，以期快速有效地提升病患、家屬之OTK。

研究結果發現家屬OTK程度略高於病患，造成這個現象的原因可能為家屬比病患更有機會與職能治療師互動、觀察治療環境。當病患專注於接受OT時，家屬在治療前後比病患有機會向治療師詢問治療進展、提出需要解決的問題。家屬

也比病患有機會觀察其他病友進行治療的情形，或與其他病友及家屬交換治療心得。雖然家屬OTK程度略高於病患，但分數仍不高。尤其OT所涵蓋的內容繁多，病患與家屬難以透過與職能治療師簡短討論、病友間互相交流資訊或自己蒐集資料而能獲得完整的OTK概念。未來若欲提升病患與家屬之OTK程度，我們亟需發展一套內容完整，並且可快速執行的OTK教材，以便職能治療師於臨床上使用。

另外，其他醫療人員對OT的瞭解也可能影響病患與家屬的OTK。中風病患在接受OT服務時，時常同時接受相關醫療人員的服務。當其他醫療人員不瞭解OT的服務內容與治療目標時，也可能提供病患與家屬不當的說明，造成他們對OT具有錯誤認識與期待 (Mackey, 2007; Wilding & Whiteford, 2007)。針對此問題之因應，作者建議職能治療學會、公會提供適用於醫療人員的OT概念介紹，以期提升其他醫療人員對OT的瞭解。甚至病患有需求時，相關醫療人員能夠適當地介紹OT。

本研究特點之一為在一次收案中，進行二次OTK訪談。由於第一次訪談採簡答方式，訪員未提供任何提示。受訪者必須立即依據自己印象最深刻的部分，立即陳述對OT各方面的認識，無法有太多時間重組各種細節，因此通常他們只能回答出部分。故本研究將第一次訪談結果視為受訪者OTK程度之低估值。第二次訪談為提供選項的選擇題，受訪者有作答線索使回答內容較為完整，因此第二次訪談的分數顯著高於第一次訪談。由第二次訪談，可得到OTK高估值。然而二次訪談的分數差異並不大（平均僅差1.3分，且第二次訪談的最高分未高於第一次訪談），顯示受訪者能透過作答線索（選項）提升的分數有限。研究者二次訪談設計可確定受訪者OTK程度之可能範圍（區間估計），比單一訪談結果（點估計）更能反映受訪者之OTK程度。

本研究發現受訪者最需要之OTK項目依序為治療目標、治療原則與治療原理，顯示病患似乎對於與自身功能恢復相關的知識最有求知慾。此結果與Maitra等人之研究結果發現相近 (Maitra & Erway, 2006)。然而，仍有少部分受訪者表示對於OTK沒有特別的需求，這可能是因為受訪者不瞭解獲得這些OTK項目對自身的幫助、習慣被動接受醫療訊息，或是因為年長而降低其增加知識的動機，因此選擇不知道或沒有想法。由於病患和家屬的OTK仍顯不足，作者建議未來提供

OTK時，可著重於治療目標、治療原則與治療原理之說明，以提供符合病患與家屬需求的OTK。

受訪者偏好之資訊傳遞方式以一對一口頭說明、衛教手冊、衛教課程最受歡迎。受訪者偏好一對一說明，可能是便於澄清自己不懂的地方。衛教手冊能涵蓋較完整的內容，且方便於家屬與照護者間傳閱。衛教課程則可於候診時間一邊上課，較符合其時間分配且便於理解。令人意外的是一般醫療院所常提供之衛教單張最不受青睞，可能是衛教單張的內容過於精簡、內容不符合病患與家屬的需求，或是他們不瞭解有看不懂的段落應向誰詢問，而且不易保存，因此較少主動取閱 (蔡湘熹、張雅慧、李清霖，民 91)。由本研究結果可推測目前OT相關機構提供之OTK衛教內容不足，最常使用之衛教形式也不受病患與家屬喜愛，大幅影響衛教成效。建議未來提供OTK時，若人力充足，則以一對一口頭說明的方式，幫助病患與家屬理解。如人力不足，則可提供衛教手冊讓病患與家屬閱讀。若有看不懂的地方，也可再與所屬治療師討論。在復健科、神經內科等相關專科之候診區，也可提供OTK的定點衛教課程，以提升病患與家屬之OTK程度。

本研究之限制有五：一、本研究使用方便樣本，僅包含一家教學醫院之中風病患與家屬。病患的年齡低於一般中風病患的平均年齡 (60歲)、且未涵蓋台語族群與有認知障礙或口語表達困難的病患，僅能詢問家屬的意見。因此本研究結果之概化仍須保留。二、OTK問卷之信度未經驗證，可能影響受測結果之穩定性。三、本研究未調查病患之病情，因此無法呈現病患之神經動作功能損傷程度。四、本研究未區分受訪家屬是否為主要照顧者，因此受訪的家屬可能不夠瞭解病患接受OT的情形，使本研究低估家屬的OTK程度。五、本研究之訪談過程未錄音，亦無逐字記錄稿，故未能進行質性分析，可能遺漏部分訊息。

結論

本研究發現中風病患與家屬之OTK程度普遍偏低，但家屬之OTK程度略高於病患，而且受訪者之OTK程度與教育程度、接受OT服務的時間長短無顯著關係。然而本研究為初步探索驗證，影響OTK之因子仍待更多的實證研究確認。受訪者

最需要的OTK為與自身功能恢復相關的資訊，最喜歡的資訊傳遞方式為一對一口頭說明。未來治療人員提供OTK時，宜以一對一口頭說明的方式，加強說明治療目標，以期提升其OTK程度以及OT效能。

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附錄1

職能治療知識問卷

指導語：以下有10個題目跟職能治療相關的問題想請教您。大部分的題目會問您二次，第一次我會唸出題目，請您依照自己的經驗，盡可能地回答，不用擔心您的答案是否正確。全部的問題都問完之後，我會問第二次，並提供您選項作選擇。如果在回答過程中有聽不懂或看不懂的地方，請隨時提出問題。

(第一次用紅筆圈選於選項的數字上，第二次用藍筆勾選於選項的數字上)

1.請問您是怎麼知道職能治療的？（獲得訊息的管道與原因）

(1)家人生病　(2)自己生病　(3)醫師轉介　(4)朋友介紹　(5)聽別人說過

(6)其他______________________________

2.請問您認為報名職能治療師執照考試的最低學歷是？（養成教育）

(1)高職 (2)五專 (3)大學 (4)研究所 (5)其他______ (6)不知道

3.請問您認為職能治療除了訓練上肢功能以外，還有那些治療或服務項目？（服務項目）

(1) 教導病人生活適應 (2)吞嚥能力訓練　(3)平衡能力訓練　(4)教導病人生活自理

(5)步態訓練　(6)製作副木 (7)居家環境設計/改造　(8)職業重建　(9)痠痛處理

(10)認知功能訓練 (11)其他________________ (12)不知道

4.請您試著說出職能治療師常用的治療器材或工具，越多越好（治療媒介）

(1)積木　(2)滑車 (3)電療　(4)彩虹橋　(5)爬升架　(6)熱敷　(7)站立架　(8)超音波

(9)日常生活活動的真實物品　(10)其他________________

5.除了中風病人之外，請問您知道還有那些人適合接受職能治療的服務？（服務對象）

(1)生理疾病（a.脊髓損傷 b.肩頸酸痛　c.燒燙傷）

(2)小兒疾病（a.自閉症 b.發展遲緩 c.癲癇）

(3)心理疾病（a.睡眠障礙 b.躁鬱症 c.失智症）

(4)其他_____________ (5)不知道

6.請問您知道除了醫院之外，還有那些地方有提供職能治療的服務？（服務場所）

(1)復健診所 (2) 長期照護機構 (3)精神科療養院 (4)職能治療所 (5)衛生局

(6)身心障礙者福利基金會（例如：伊甸、陽光） (7)學校 (8) 其他__________

(9)不知道

7. 請問如果要接受職能治療，到醫院可以掛那些科？掛號一次可以做幾次治療？

(1)科別：（a. 復健科 b.骨科 c.神經科 d.放射科 e.精神科 f.兒童心智科 g.外科 h.其他__________________ i.不知道）

(2)治療次數：________次 a.不知道

8.請問您認為職能治療和物理治療有什麼不同？（專業區別）

(1)PT （a.下肢功能 b.粗大動作 c.較多體能訓練 d.儀器治療 e.運動傷害治療）

(2)OT （a.上肢功能 b.精細動作 c.生活自理 d. 功能性訓練 e.認知功能訓練）

(3)其他_________________

(4)不知道 (5)不在意

9. 如果您想多瞭解職能治療，請問您還希望多瞭解「職能治療」的那些內容？（知識需求）

(1)定義 (2)治療目標 (3)治療原則 (4)治療原理 (5)服務項目 (6)服務場所 (7)服務對象

(8)相關補助與法規 (9)活動目的 (10)其他_______________ (11)不知道/沒有想法

指導語：接下來，我會從頭再問一次，請您參考題本上的選項作答。請留意，每個題目可能有一些選項是錯誤的，請小心作答。（從第2題開始）

10.請問您認為用什麼方法，可以幫助您更瞭解職能治療？請指出**3**項您最喜歡的職能治療資訊傳遞方式。越先指出的項目表示越喜歡。（宣傳媒介）

(1)衛教單張 (2)衛教手冊 (3)網頁介紹 (4)教學光碟 (5)電視廣告 (6)醫院電視

(7)衛教課程 (8)醫療人員一對一口頭說明 (9)其他_____________________________

附錄2

（一）二次訪談的差異

內容方面，包含題數與題目敘述的不同。題數部分，第一次訪談時，訪員僅依據題本，訪談第1-9題。第二次訪談僅詢問第2-10題。由於第1題（獲得訊息的管道與原因）僅與自身經驗相關、第7.(2)題（治療次數）與第10題（偏好之資訊傳遞方式），皆不會因為詢問兩次或提供選項而使受訪者改變作答，因此只於詢問一次。

題目敘述部分，第9題在第一次訪談皆為簡答題，第二次訪談時，受訪者須依照其認知、需求與喜好程度，選出三個較適當的選項並排序。

（二）OTK問卷評分標準：以OT服務場所為例

若受訪者可選出復健診所、長期照護機構、精神科療養院、職能治療所、身心障礙者服務機構、學校等適當選項，則得2分。若未選出上述所有項目，或有選出上述任一項目以上，又包含其他不適當的選項（例如：衛生局），則得1分。其餘則為0分。若個案所回答的其他答案亦符合題目所需，也得1分。例如：第4題（治療媒介）回答出套杯、插棒組、螺帽組等器材，每回答一個，就等同於說出一個適當選項。第5題（服務對象）若受訪可回答出肢體障礙、或任何身心障礙者皆適合接受OT，得2分。回答車禍意外、跌倒骨折、職業災害等與OT服務對象相關的答案，得1分。

此二部分的分數平均，則為受訪者的OTK程度。由於7.(2)題（治療次數）只詢問一次，但訪問第二次並不會改變受訪者的作答，因此此題於第二次訪談的計分，與第一次訪談的得分相同。二次訪談的滿分皆為13分。分數越高，表示程度越好。

Journal of Taiwan Occupational Therapy Association
2012, 30(1), 34-52

CME/ Original article

A Preliminary Investigation of Stroke Patients' and Families' Level of Knowledge of Occupational Therapy

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Abstract

Occupational therapy knowledge (OTK) is knowledge about occupational therapy (OT), and is important to patients and their families. A lack of OTK may decrease patients' and families' compliance to OT and OT's efficacy. This study was designed to investigate both stroke patients' and their families' OTK levels, and what affected those levels. We also investigated the OTK domains where they needed more OTK knowledge, and the preferable ways to deliver OTK. Participants were interviewed twice to get the upper and lower bounds of OTK levels. The first interviews were in the form of a short-answer questionnaire, and the second interviews, a multiple-choice questionnaire (score range 0-13). We examined association between OTK levels of participants and demographic characteristics. Finally, we summed up the ranks of needed OTK domains and preferred ways for delivery. Fifty one participants (29 patients) participated in this study with a mean OTK score, 6.8, of both interviews. We found that OTK levels only significantly differed from patient or family (p = .025), but not significantly differed in terms of participants' educational levels, length of time receiving OT intervention, and age. Participants reported a need to know the treatment goals of OT and a preference for one-to-one explanation. We found that the stroke clients' and their families' OTK levels generally tended to be low, and were related to neither educational levels, nor length of time they had been receiving OT. Explaining OT treatment goals to clients and their families in one-to-one fashion is recommended.

Keywords: *Occupational therapy knowledge, Stroke, Questionnaire, Compliance*

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Received: 11 October 2011
Accepted: 27 December 2011

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職能治療學會雜誌
民國 101 年 30 卷第 1 期頁 53-67

原著

中風病患整體健康相關生活品質之關聯因素探討

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摘要

健康相關生活品質 (health-related quality of life, HRQOL) 反映中風病患主觀感受，而整體HRQOL (overall HRQOL, O-HRQOL) 可綜合呈現病患之整體健康狀態，方便臨床人員瞭解病患之病情。而且O-HRQOL以單一數值呈現，方便臨床人員解釋病患之評估結果，有助於提升臨床效率。然而研究人員對於影響O-HRQOL之相關因素仍然所知有限，造成臨床人員難以制訂提升病患O-HRQOL之計畫。因此本研究之目的為探討與中風病患O-HRQOL相關之因素。130位中風滿一年之病患接受5個量表 (巴氏量表，Barthel Index, BI；芙蘭切活動量表，Frenchay Activities Index, FAI；福格邁爾運動量表，Fugl-Meyer Motor Assessment, FMA；福格邁爾運動量表的平衡次量表，Fugl-Meyer Balance Subscale, FMB；中風病患專屬生活品質量表，Stroke-Specific Quality of Life, SSQOL）的評估。研究者先以*t*檢定比較不同人口學特性病患間之SSQOL分數是否有顯著差異，並計算SSQOL與其它4個量表得分之相關程度 (Pearson's *r*)。再以逐步迴歸分析 (stepwise regression) 驗證中風後一年O-HRQOL之相關因素。研究者發現病患的SSQOL得分與其年齡、BI總分、FAI總分、FMA總分及FMB總分有顯著關聯 ($p < .001$)。逐步迴歸分析結果發現BI總分、FAI總分與FMA總分為解釋中風後一年O-HRQOL之重要因素 ($R^2 = .66$)。以上結果顯示：ADL功能與動作控制能力為O-HRQOL之主要相關因素。此結果亦支持職能治療之理念：促進病患之日常生活活動功能可提升病患之HRQOL。

關鍵字：健康相關生活品質，中風，日常生活活動，動作控制

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受文日期：民國 101 年 3月 14 日
接受刊載：民國 101 年 4 月 23 日

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前言

健康相關生活品質 (health-related quality of life, HRQOL) 為病患主觀對各種健康層面的感受，可幫助臨床或研究人員從病患實際感受中直接瞭解病患之健康狀態（姚開屏，民 91）。病患於中風後之生理、心理、認知等健康層面皆可能深受影響 (Kim, Warren, Madill, & Hadley, 1999)，而且即使病患的功能復原良好，中風1年後之HRQOL仍然不佳 (Haacke et al., 2006; Sturm et al., 2004)。因此，臨床或研究人員常利用HRQOL問卷以掌握中風病患自覺健康狀態，以呈現病患之病情並追蹤評估病患接受治療的成效 (Williams, Weinberger, Harris, Clark, & Biller, 1999)。

一般HRQOL問卷測量多層面健康之概念，測量結果分數有二種解釋方式：一、各層面之HRQOL：臨床或研究人員剖析病患個別層面之HRQOL，以呈現病患不同層面之健康狀態。二、整體HRQOL：整體HRQOL (overall HRQOL, O-HRQOL) 為綜合病患個別健康層面，以利臨床或研究人員瞭解病患整體的健康狀態（姚開屏，民 89）。例如：中風病患專屬生活品質量表 (Stroke-Specific Quality of Life, SSQOL) 的總分可代表中風病患之O-HRQOL狀態。由於O-HRQOL僅以單一數值呈現，易於臨床或研究人員解讀 (Williams et al., 1999; Wittes, 2002)。

一些研究曾探索影響中風病患HRQOL之因素，發現諸多影響中風病患HRQOL之因素，包括：年齡、教育程度、工作狀況、經驗狀況、疾病嚴重程度、動作功能、日常生活活動 (activities of daily living, ADL) 等 (Leach, Gall, Dewey, Macdonell, & Thrift, 2011; Naess, Waje-Andreassen, Thomassen, Nyland, & Myhr, 2006; Pan, Song, Lee, & Kwok, 2008; Singhpoo et al., 2011; Sturm et al., 2004)。然而過去研究有二點不足之處：一、多數研究以各層面HRQOL分數分析影響中風病患HRQOL之因素 (Naess et al., 2006; Pan et al., 2008; Singhpoo et al., 2011)。個別層面HRQOL分數之使用，僅表示該個別健康層面受到特定因素之影響，並非表示病患O-HRQOL皆受此因素影響。二、未使用特定疾病健康相關生活品質 (disease-specific HRQOL) 問卷。Sturm等人 (2004) 及Leach等人 (2011) 曾驗證影響中風病患O-HRQOL之因素，但使用一般HRQOL問卷。一般HRQOL問卷

之測量結果可用來比較不同族群之間的差異，但不能反映中風病患所特別關注之HRQOL。由於過去研究尚未確定中風病患O-HRQOL之相關因素，造成臨床/研究人員無法有效地掌控相關因素以提升病患之O-HRQOL。因此本研究目的為探討與中風病患O-HRQOL相關之因素。

研究方法

一、研究對象

樣本選自發病時間為一年並於北部某醫學中心出院之中風病患，篩選標準如下：(一)、診斷：中風病患之診斷類別依國際疾病分類 (ICD-9-CM) 為參考依據（中華民國醫院行政協會病歷委員會，民 82)，凡被歸類為ICD-9-CM430（蜘蛛膜下腔出血），431（腦內出血），432（其他未明示之顱內出血），433（腦前動脈阻塞及狹窄），434（腦動脈阻塞），436（診斷欠明之腦血管疾病），或437（其他及診斷欠明之腦血管疾病）皆為本研究之對象；(二)、首次中風或重複發病者；(三)、能聽從單步驟之口令 (one-step command) 者；(四)、沒有伴隨其他重大疾病（如：惡性腫瘤、截肢等）。符合上述標準之病患，研究者會向病患說明本研究的目的、程序，病患充分理解相關訊息，且同意參與本研究的施測，簽署研究計畫同意書，即為本研究之個案。本研究由醫學中心之倫理試驗委員會審核通過。

二、研究流程

病患於家中接受一位經訓練且熟悉量表之職能治療師評估。本研究所使用之量表皆於個案家中進行評估，評估方式如巴氏量表 (Barthel index, BI) 與芙蘭切活動量表 (Frenchay Activities Index, FAI) 則由評估者口頭訪問病患；福格邁爾運動量表 (Fugl-Meyer Motor Assessment, FMA) 與福格邁爾運動量表的平衡次量表 (Fugl-Meyer Balance Subscale, FMB) 則由評估者實際施測項目並觀察病患之動作表現;中風病患專屬生活品質量表 (Stroke-Specific Quality of Life, SSQOL) 主要為

病患自行填寫。如病患無法親自回答或填寫問卷，則由評估者以訪問方式請代理人代為陳述。代理人以主要照顧者或配偶為主。病患的基本資料（如年齡、性別等）及病情資料（如診斷、發病日期等）皆由查閱病歷記錄獲得。

三、評估工具

BI (Collin, Wade, Davies, & Horne, 1988) 為一國內外廣泛使用之評估基本日常生活活動 (basic activities of daily living, BADL) 功能的工具，主要評估病患10項自我照顧 (self-care) 表現，包含進食、盥洗、如廁、移位、穿衣、行走、輪椅使用、大小便控制、上下樓梯等。病患於各項之得分可加總累積，最低0分，最高20分，分數愈高代表ADL功能愈獨立。BI應用於中風病患具有良好的信度、效度及反應性 (Hsueh & Hsieh, 2001; Hsueh, Jeng, & Hsieh, 2002)。

FAI為工具性ADL (instrumental ADL, IADL) 量表，用於評量中風病患生活型態，其項目涵蓋較高階層之社會生活能力（謝清麟，民 86）。 FAI共有15個項目，可分為三大部分: (一) 、家務事; (二) 、戶外活動; (三) 、休閒與工作。FAI施測簡便，約可於十至十五分鐘內完成。每個項目之評分依活動頻率高低而給予0分至3分，十五個項目得分範圍為0至45分。分數越高表示IADL功能越佳。FAI量表具備內在一致性及建構效度，適於評量中風病患之生活型態（謝清麟，民86）。

FMA (Fugl-Meyer, Jaasko, Leyman, Olsson, & Steglind, 1975) 為國內外廣泛使用之評估中風病患動作控制能力的量表，評估項目包含六大項：上下肢動作功能、關節活動度 (range of motion)、疼痛、感覺缺失及平衡能力。評分方式為0-2分，共三個等級；病患完全無法從事者得0分，能獨立完成者得2分。此量表具良好之信度及效度 (Duncan, Propst, & Nelson, 1983; Sanford, Moreland, Swanson, Stratford, & Gowland, 1993)。本研究採用FMA之上、下肢體動作功能二個次量表，藉以呈現病患動作缺失之嚴重程度。FMA包含上肢33個項目，下肢17個項目，共50個項目，總分為0-100分。

FMB (Berg, Maki, Williams, Holliday, & Wood-Dauphinee, 1992) 共有7項目，

其中包含3個坐姿平衡項目：維持坐姿能力、健側降落傘反應 (parachute reaction in non-affected side)、患側降落傘反應 (parachute reaction in affected side)；及4個站立平衡項目：扶持下站立能力、獨立站立能力、健側腳站立能力、及患側腳站立能力。FMB總分為0-14分。由於降落傘反應之測試需在病患閉眼下，由施測人員用力向病患患側或健側推動，病患容易因此受到驚嚇，造成病患或家屬不解，且部分病患之健側或患側降落傘反應不易被誘發出來，故學者指出這二個項目缺乏內容效度，與其它姿態控制項目較為不同，而且是造成坐姿平衡項目信度不佳的主要原因 (Malouin, Pichard, Bonneau, Durand, & Corriveau, 1994; Poole & Whitney, 1988)。所以本研究仿效昔日研究的作法（薛漪平、毛慧芬、黃小玲、謝清麟，民80；Mao, Hsueh, Tang, Sheu, & Hsieh, 2002)，在施測過程中，若病患之降落傘反應沒被誘發出來，且仍能保持平衡時，則不用更大力量去推動病患，以免嚇到病患，在評分上則給予2分。

SSQOL (Williams et al., 1999) 為專為中風病患設計並以病患為中心的方式發展之問卷。SSQOL包含生理、心理、社會等12個層面，涵蓋行動、精神體力、上肢功能、工作/生產力、心情、自我照顧、社會角色、家庭角色、視力、語言、思考、個性等，共49個項目評估病患目前之O-HRQOL。SSQOL評分方式皆為1-5分，個案回答之選項包含3種：(一)、「完全需要幫忙」至「完全不需要幫忙」，例如: 1分表示病患無法自行上下樓梯，完全需要他人幫忙，5分表示病患能自行上下樓梯，完全不需他人幫忙；(二)、「完全無法做到」至「完全沒有困難」，例如: 1分表示病患自覺困難，完全無法自行準備餐點，5分表示病患自覺完全沒有困難，可自行準備餐點；(三)、「非常同意」至「非常不同意」，例如: 1分表示病患非常同意自己無法專心，5分表示個案非常不同意自己無法專心。本研究SSQOL之計分方式為加總12個層面之項目平均分數，以獲得病患之O-HRQOL分數 (Hsueh, Jeng, Lee, Sheu, & Hsieh, 2011)，總分範圍為12-60分。代理人與病患填寫SSQOL於總分之一致性為中度 (Williams et al., 2006)。

四、資料分析

所得資料分析如下：（一）、單變項分析 (univariate analysis)：以Pearson's *r*檢驗病患中風後一年之BI總分、FAI總分、FMA總分、FMB總分等變項與SSQOL總分之關聯程度，並以獨立樣本*t*檢定檢驗不同特性之病患（性別、患側、是否為初次中風與診斷）之SSQOL分數是否有顯著差異；（二）、多變項分析 (multivariate analysis)：以逐步迴歸分析 (stepwise regression) 檢驗與中風病患生活品質之相關因素。本研究驗證可能之相關因素包含：性別、年齡、患側、是否為初次中風、診斷、BI總分、FAI總分、FMA總分與FMB總分等。研究者考量變項間可能有高相關而有共線性 (collinearity)，違反迴歸分析之假設，因此研究者排除共線性指標 (variance inflation factor, VIF) 大於10的變項 (Kutner et al., 2005)，以避免變項之共線性影響迴歸模型的估計結果。

結果

共有130位中風病患參與研究。平均年齡約65歲，其中85位為男性。42位 (32.3%) 病患無法親自回答或填寫SSQOL問卷，由配偶代替之。BI平均約17分，顯示個案之平均BADL能力為輕度失能。FMA總分平均為75分，顯示個案之平均動作能力為中等以上。病患中風後一年之基本資料及病情資料列於表1。

單變項分析結果發現與SSQOL總分顯著相關之變項包含：病患之年齡、BI總分、FAI總分、FMA總分、FMB總分 ($p < .001$)。上述5個變項中，年齡與SSQOL為低度負相關 ($r = -.21$)，其餘變項與SSQOL為高度正相關 ($r \geq .65$)。中風病患之其它人口學特性 (含性別、患側、是否為初次中風、診斷）與SSQOL分數則未達顯著關聯（$p \geq .416$）（表2）。在各獨立變項間的相關分析中，BI總分、FAI總分、FMA總分與FMB總分彼此間為高相關（$r \geq .53$），但上述4個變項的VIF值皆小於10 (VIF ≥ 3.4)，未達共線性之標準。

表1

病患基本資料（*n* ＝130）

人口學變項	
性別	
男	85 (65%)
女	45 (35%)
年齡 (mean ± *SD*)	64.9 ± 10.3
患側肢體	
左	76 (58%)
右	54 (42%)
是否為初次中風	
是	117 (90%)
否	13 (10%)
診斷（出血/缺血）	
出血	34 (26%)
缺血	96 (74%)
BI總分(0-20)* mean ± *SD*	17.1 ± 4.4
FAI總分(0-45)* mean ± *SD*	11.0 ± 10.3
FMA總分(0-100)* mean ± *SD*	75.0 ± 29.6
FMB總分(0-14)* mean ± *SD*	10.9 ± 2.9
SSQOL總分(12-60)* mean ± *SD*	43.1 ± 10.3

註：BI, Barthel Index; FAI, Frenchay Activities Index; FMA, Fugl-Meyer Motor Assessment; FMB, Fugl-Meyer Balance Subscale; SSQOL, Stroke-Specific Quality of Life.
*量表之可能得分範圍。

表2

中風發病一年時人口學變項及病情變項與SSQOL總分之關聯程度單變項檢定

變項	SSQOL		
	差異或關聯		*p*值
	*t*值	Pearson’s *r*	
性別	0.80	-	.423
患側	0.82	-	.416
是否為初次中風	1.80	-	.704
診斷	0.81	-	.423
年齡	-	- .21	.019
BI	-	.73	<.001
FAI	-	.70	<.001
FMA	-	.66	<.001
FMB	-	.65	<.001

註：BI, Barthel Index; FAI, Frenchay Activities Index; FMA, Fugl-Meyer Motor Assessment; FMB, Fugl-Meyer Balance Subscale; SSQOL, Stroke-Specific Quality of Life.

在逐步迴歸分析的過程中，BI總分為最先被選入迴歸模型的變項。此單一變項可解釋SSQOL分數變異量的53%，為所有變項中最能解釋SSQOL分數變化者。後續，迴歸模型加入FAI總分，可再解釋11% SSQOL分數的變異。最後迴歸模型再加入FMA總分，可再解釋2% SSQOL分數的變異（表3）。其餘影響力未達顯著而未列入迴歸模型的6個變項為性別、年齡、患側、是否為初次中風、診斷、與FMB總分。

表3
中風病人發病一年後整體健康相關生活品質最佳相關因素之逐步迴歸分析

模式	影響因素	*B*	*Beta*	*T*	*p*值	R^2
1	BI	1.70	0.73	12.0	<.001	.53
2	BI	1.14	0.49	7.5	<.001	.64
	FAI	0.41	0.41	6.3	<.001	
3	BI	0.87	0.37	4.5	<.001	.66
	FAI	0.39	0.38	5.8	<.001	
	FMA	0.06	0.18	2.3	.023	

註： BI, Barthel Index; FAI, Frenchay Activities Index; FMA, Fugl-Meyer Motor Assessment; FMB, Fugl-Meyer Balance Subscale.
*列入分析但效果不顯著之變項包含：性別、年齡、患側、是否為初次中風、診斷與FMB總分。

討論

本研究發現BI分數與SSQOL有高度相關，而且逐步迴歸分析發現BI分數為SSQOL分數最主要之相關因素，可解釋一半以上變異量。因SSQOL反映中風病患之O-HRQOL，由此可知提升BADL功能對於促進病患之O-HRQOL之重要性。此結果與過去研究之發現相似：中風病患BADL功能之恢復越佳，越能減少其依賴程度，而HRQOL也隨之提升 (Leach et al., 2011)。臨床上，BADL之獨立程度為中風復健之重要成效指標之一 (Duncan, Jorgensen, & Wade, 2000; Kelly-Hayes et al., 1998)，職能治療 (occupational therapy, OT) 亦常以促進中風病患獨立執行BADL為治療核心。故本研究結果支持OT臨床實務以由上而下的介入方式 (top-down approach)，著重於加強個案的職能表現，將訓練病患之BADL列為主要復健目標之意義與價值 (Fisher, 1998; Trombly, 1993)。

本研究另發現：控制BI分數之影響後再加入FAI總分變項，可增加11%

SSQOL分數之解釋變異量。此結果顯示IADL亦為O-HRQOL之主要相關因素之一。IADL涵蓋較廣之生活型態，其項目需病患主動參與或安排之活動，如購物、旅遊、洗衣、社交等，為影響中風病患生活獨立自主之指標。過去研究也指出IADL功能越佳的中風病患其HRQOL越好。當病患之IADL功能越差，中風病患對照護之依賴性越高，其HRQOL亦較低 (Leach et al., 2011)。因此，促進中風病患之IADL功能或可提升其O-HRQOL。

本研究亦發現FMA分數為另一SSQOL分數的主要相關因素。單變項分析結果得知FMA與SSQOL為高度相關，且FMA和BI分數亦達高度相關。因此，在迴歸分析中，控制BI和FAI分數影響後，FMA分數增加解釋的變異量較小，可能是FMA的影響部分已被BI和FAI的分數所解釋所致。過去研究顯示中風患者動作控制能力不佳，會影響或限制其從事各項活動之表現，使其常需仰賴他人協助，以致降低中風患者自主性，進而影響其HRQOL。病患之動作控制能力不佳，亦直接影響其生理層面之HRQOL (Gadidi, Katz-Leurer, Carmeli, & Bornstein, 2011)。因此，雖然FMA可增加解釋的變異量不大，動作控制能力仍為O-HRQOL的主要相關因素之一。本研究結果支持OT臨床實務以由下而上的介入方式 (bottom-up approach)，加強個案的能力的組成因素（例如：肌肉力量、動作控制能力），以訓練病患之動作控制能力之意義與價值 (Fisher, 1998; Giles, 2010)。

在單變項分析中，病患的年齡及平衡能力皆與SSQOL分數有顯著相關。然而在多變項分析中，年齡與平衡能力並未列入最終的迴歸模型中。此結果可能表示年齡與平衡能力的影響已經被其它變項所解釋。以年齡為例，病患的年齡越大，執行ADL的能力通常會越差 (Gadidi et al., 2011; Veerbeek, Kwakkel, van Wegen, Ket, & Heymans, 2011)。雖然有部分研究指出年齡為中風病患O-HRQOL之相關因素 (Paul et al., 2005 ; Sturm et al., 2004)，但年齡的影響可能已經被BI與FAI的分數所解釋，因此未列入最終迴歸模型。就平衡能力而言，由於病患之平衡能力與動作能力為高相關，FMB的影響可能已被FMA的分數所解釋，因此平衡能力並未列入最終的迴歸模型。由上述結果得知，年齡與平衡能力對於病患之O-HRQOL仍為重要的影響變項。此結果可提供臨床治療做為參考，將有助於OT訂定復健目標與治療計畫。

本研究用於探討O-HRQOL相關因子的4個量表 (BI、FAI、FMA與FMB) 與SSQOL的部分層面相似，可能造成高估此4個量表之分數與SSQOL總分之相關程度，然而此4個量表與SSQOL所評量的構念 (construct) 及評分不同。如BI之評量構念為基本日常生活動之實際表現（評分為「完全不獨立」-「完全獨立」），SSQOL的自我照顧層面則評量個案於日常生活活動之自覺困難程度（「完全無法做」-「完全沒有困難」）。FAI之評量構念為社區生活的實際表現（評分為執行頻率），SSQOL的家庭角色與社會角色二層面則有部分項目與FAI相似，但題目之評量構念為個案對參與家庭生活與社交活動之感受 (feeling)。

FMA之評量構念為個案特定動作之控制能力（評分為「完全無法從事」-「可以獨立完成」），SSQOL的上肢功能與行動層面則評量個案於日常環境中的上肢活動與行動能力之自覺困難程度（「完全無法做到」-「完全沒有困難」）。FMB之評量構念為個案特定姿勢或動作之平衡能力（「完全無法從事」-「可以獨立完成」），SSQOL的行動層面則評量個案於日常環境中的各項活動之自覺困難程度（「完全無法做到」-「完全沒有困難」）。

綜合以上，BI等4量表與SSQOL之評量構念及計分方並不相同，且SSQOL包含生理、心理、社會等12個層面，因此BI等4個量表之項目雖與SSQOL部份相似，但影響相關程度應屬有限。

本研究的限制有二項：一、本研究之病患皆來自同一醫療機構且皆為發病後一年。二、本研究之多變項分析未納入疲倦、疼痛等中風相關症狀，以及情緒（例如：焦慮、憂鬱）的影響。這些限制影響本研究結果之概化。

結論

本研究以逐步迴歸分析檢驗中風病患發病後一年O-HRQOL之相關因素，結果發現ADL功能與動作控制能力為O-HRQOL主要相關因素。此結果亦支持職能治療之理念：促進病患之ADL功能與動作控制能力有助於提升病患之HRQOL。

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Journal of Taiwan Occupational Therapy Association
2012, 30(1), 53-67
Original article

Factors Predicting Overall Health-Related Quality of Life in Patients with Stroke

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Abstract

Health-related quality of life (HRQOL) reflects the subjective experience of patients. Overall HRQOL (O-HRQOL) provides patients' a summarized health status, which helps clinicians determine patients' overall condition. O-HRQOL is displayed in a single index, which is useful for clinicians to interpret the result of assessment and to promote the efficiency of patient management. However, the factors related to stroke patients' O-HRQOL are largely unknown, limiting clinicians' efficiency of patient management. We aimed to investigate the factors associated with O-HRQOL in patients with stroke. One hundred and thirty one-year post stroke survivors were assessed for activities of daily living (ADL) functions (using the Barthel Index, BI and Frenchay Activities Index, FAI), motor control (using the Fugl-Meyer Motor Assessment, FMA), balance (using the Fugl-Meyer Balance Subscale, FMB), and O-HRQOL (using the Stroke-Specific Quality of Life, SSQOL). The data were examined using an independent samples t-test to analyze the difference between the characteristics of stroke patients and the summarized SSQOL scores. Pearson's r was used to determine the relationships between the summarized SSQOL scores and the scores of the other measures (BI, FAI, FMA, and FMB). Stepwise regression analysis was used to identify factors associated with SSQOL scores. We found that the SSQOL score was associated with age, BI score, FAI score, FMA score, and FMB score ($p < .001$). Regression analysis showed that BI score, FAI score, and FMA score were strongly related to O-HRQOL ($R^2 = .66$). These results showed that ADL and motor control are important factors associated with O-HRQOL in patients with stroke

Keywords: *Health-related quality of life, Stroke, Activities of daily living, Motor control*

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Received: 14 March 2012
Accepted: 23 April 2012

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Journal of Taiwan Occupational Therapy Association
2012, 30(1), 68-86

CME/ Original article

Improving Physical Fitness in Children with Down Syndrome

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Abstract

Children with Down syndrome are in need of effective and motivating physical fitness training programs. The effectiveness of an exercise training program for 65 children with DS randomly assigned to two intervention groups (exercise group vs. control group) was evaluated. The mean age for the exercise (n = 33) and the control group (n = 32) was 10.6 ± 3.2 and 11.2 ± 3.5 respectively. The training program consisted of a 10-minute treadmill exercise and one 30-minute virtual-reality based activity administered three times a week for 10 weeks. The exercise group had significant improvements in cardiovascular functions, body strength, and body composition in comparison to the control group. A short-term physical fitness program used in this study is capable of improving physical fitness of children with DS to reduce potential health risks associated with poor fitness and sedentary lifestyles.

Keywords: *Down syndrome, Physical fitness, Exercise program*

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Received: 6 March 2012
Accepted: 19 April 2012

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1. Introduction

Down syndrome (DS) is a chromosomal anomaly with incidence of around 1/700 to 1/1000 live births (Roizen, 2002). DS is the most common single cause of intellectual disabilities (ID) (Menkes & Falk, 2005), with between 70% and 75% of individuals with DS attaining an IQ of between 25 and 50 by the first decade of life (Vicari, 2006). DS is associated with a distinct profile of developmental outcomes regarding body functions and activity performance (Fidler, Hepburn, Mankin, & Rogers, 2005); with evidence for great variation in the range and level of deficits resulting from biological and environmental factors (Turner & Alborz, 2003).

Growing evidence has shown that regular physical activity has positive effects on cardiovascular function, psychosocial well-being, work performance, and activity participation (Baynard, Pitetti, Guerra, Unnithan, & Fernhall, 2008). Additionally, persons with higher levels of physical activities have a reduced risk of various chronic conditions and are more physically independent in later life (Caruso, Silliman, Demissie, Greenfield, & Wagner, 2000). However, individuals with DS show a considerable lack of physical fitness as well as very low levels of cardiovascular endurance (Lotan, Isakov, Kessel, & Merrick, 2004). Pitetti and Campbell (1991) highlighted the poor health status of persons with ID and DS and referred to them as a population at risk. A number of factors may account for the low levels of fitness found in persons with ID including a passive lifestyle (Lotan et al., 2004; Pitetti & Boneh, 1995), psychological and physiological barriers (Fernhall & Pitetti, 2001), low motivation (Halle, Gabler-Halle, & Chung, 1999; Temple, 2007), and limited motor functions (Wuang & Su, 2012). Of all the factors examined, an inactive life style appears to be most detrimental to physical fitness (Lotan, Yalon-Chamovitz, & Weiss, 2009). Individuals with DS continue to engage in high rates of sedentary behavior (Hoge & Dattilo, 1995) and have extremely low levels of physical fitness (Fernhall & Pitetti, 2001) when they reach adolescence and adulthood (Wuang & Su, 2012). This increases the likelihood that persons with DS will have greater difficulty maintaining their abilities in work, recreation, and performance of self-care activities as they age (Graham & Reid, 2000). Since poor physical fitness appears to be a risk factor for exacerbating the disabilities associated with ID (Fujira & Fitzsimmons, 1997), considerable effort has been expended to enroll these individuals in a variety of training programs intended to improve their physical fitness (Halle et al., 1999; Lotan et al., 2004; Lotan, 2007). These programs achieved improvement in various domains, such as muscle tolerance, muscle strength, and physical fitness.

Virtual-reality based (VR-based) activities were proved to be effective in improving the motor functions and physical fitness of children with ID (Lotan, Yalon-Chamovitz, & Weiss, 2010; Wuang, Chiang, Su, & Wang, 2011). Nintendo introduced a novel style of VR (Wii, 2006) by using a wireless controller that interacts with the player through a motion detection system and its avatar representation in the video. The acceleration sensors embedded in the controllers could be responsive to the changes in speed, direction, and acceleration/deceleration that enable participants to interact with the games while performing different movements. The movements performed by the children could be captured and reproduced on the screen via the infrared light sensor mounted on TV top. The feedback provided by the TV screen as well as the opportunity to observe their own movement in real time, generates positive reinforcement, thus facilitating training and task improvement (Saposnik et al., 2010). Several distinctive features favored the selection Wii over other VR systems, including novel and widely available 3D technology using gaming simulations, affordability, and clinical applicability using simple graphics with real-time feedback with the intellectual limitations in DS. Provision of multimodal sensory feedback with the avatar could allow adjustments while children perform and self-observe the execution of diverse tasks.

To date, scant data is available on exercise interventions involving a substantially larger sample of children with DS. Improvement of physical fitness in childhood might lead to a healthier and active lifestyles in adults with DS. To better understand the potential training adaptation in this population, this study aimed to conduct a clinical trial to evaluate the effect of a combined program of strength and cardiovascular conditioning in a cohort of children with DS. Both of these components of physical fitness are of crucial importance in maintaining optimal cardiovascular health and sufficient musculoskeletal function to participate in various activities with less physiological stress (American College of Sports Medicine, 2000).

2. Methods

2.1. Participants

The study was conducted during 2009-2011 and approved by the Institutional Review Board of the Kaohsiung Medical University Hospital. The inclusion criteria of the target population were (1) age 6-12 years and current primary school enrollment; (2) diagnosis of DS by board-certified physician; (3) able to understand instructions and complete all physiological testing; and (4) written consent by one parent indicating their agreement to participate in the study. Children with coexisting blindness, deafness, or previous neurological impairments were excluded. Children who had received any physical or occupational therapy in the year preceding the study were also excluded.

Children with DS were recruited from 17 primary schools and 4 institutions serving individuals with disabilities in the Kaohsiung metropolitan area. The researchers first contacted the school nurses, teachers and directors at each participating facility to explain the goals and procedures of the study and to ask them to suggest children eligible for the study. Families expressing interest in participating were sent detailed written information about the study. The parents/caregivers were also informed that their children would be randomly selected to be in the control or exercise group, and they would not receive the exercise program if they were chosen for the control group. An occupational therapist then met with one parent of each child to assess whether the child was eligible.

Of the 100 participants assessed, 25 (25.0%) were ineligible, and 10 (10.0%) refused to participate. The remaining 65 participants were randomly assigned to either an exercise group (*n* = 33) or to a control group (*n* = 32). All parents consented before the study started. After signing the consent document, the participants had the tests of physical fitness measured including the Bruininks–Oseretsky Test of Motor Proficiency-Second Edition, the Improved Cooper test, the Energy Expenditure Index, and the Total Heart Beat Index.

2.2. Instruments

2.2.1. Demographic questionnaire

This study-specific demographics questionnaire included data on family sociodemographic status, child's health status, medications, treatments and paramedical therapies.

2.2.2. *Bruininks–Oseretsky Test of Motor Proficiency-Second Edition (BOT-2)*

The BOT-2 (Bruininks & Bruininks, 2005) assesses proficiency in four motor-area composites for individuals aged 4 through 21. Fine manual control composite measures the motor skills involved in tasks requiring precise control of finger and hand movements. Manual coordination composite evaluates speed, dexterity, and coordination of upper extremities. Body coordination composite taps the balance and motor skills required for successful participation in sports while strength and agility composite assesses large muscle strength, running speed, and postural control during walking and running. The four composite scores are combined to yield a total motor composite score. For the composites, internal consistency reliability coefficients ranged from .78 to .97, test-retest coefficients over an interval of 7-42 days ranged from .52 to .95, and inter-rater reliability coefficients exceeded .92 (Bruininks & Bruininks, 2005). The BOT-2 had good reliabilities (internal consistency, test–retest reliability, responsiveness) and construct validity in children with ID (Wuang, Lin, & Su, 2009; Wuang & Su, 2009). The strength and agility composite (SAC) used in the present study included five items: standing long jump, push-ups, sit-ups, wall sit, and V-up. The average age-adjusted standard scores for composites are 100 (*SD* = 15).

2.2.3. The Energy Expenditure Index (EEI)

The EEI is a clinical test developed to evaluate the influence of intervention programs on the efficiency of gait (Grant, Corbett, Amjad, Wilson, & Aitchison, 1995). The EEI, in units of beats/meters, is a ratio of the change in heart rate to walking velocity, and is calculated from the formula: EEI = (walking heart rate - resting heart rate) / walking velocity (Wiart & Darrah, 1999). EEI-based heart rate has been used to compare the economy of walking at various speeds by individuals with and without cerebral palsy (CP) and was found to be a useful clinical indicator of oxygen consumption at self-paced ambulation speeds in individuals with spastic diplegia CP (Norman, Bossman, Gardner, & Moen, 2004). The mean normative value for the EEI test is 0.47 ± 0.13 beats/m for typically developing children. EEI value greater than that range represented increased oxygen consumption during gait.

2.2.4. The Improved Cooper Test

It was first developed by Cooper (1968), and later revised to assess the distance covered in 12 min by individuals with chronic bronchitis. This test was later shown to be suitable to be administered to individuals with a variety of diagnoses to detect physiological change following an exercise program (Cockcroft, Saunders, & Berry, 1981; Noonan & Dean, 2000). It is a simple, inexpensive test that is easy to administer and the task corresponds with functional activities used in typical daily situations. Furthermore, the use of a target time to complete the task rather than a predetermined distance and the fact that the individuals can set their own pace (and even stop if necessary) makes it a better test of endurance that renders it suitable for individuals with ID (McGarvin, Gupta, & McHardy, 1976). The normative values for the Cooper test are considered poor if the distance is < 1500 m for female and < 2100 m for male around the age range of our participants (McGarvin et al., 1976).

2.2.5. The Total Heart Beat Index (THBI)

The THBI (Hood, Granat, Maxwell, & Hasler, 2002) is a simply calculated variable derived from continuous heart rate data and provides a reproducible alternative to gas analysis and the Physiological Cost Index (PCI) where THBI = the total heartbeats during a given exercise period/total distance traveled in meters. The THBI shows high repeatability under both steady-state and non-steady-state conditions. Normative THBI values were found to range between 0.9 and 2.2 heartbeats/m (Hood et al., 2002).

2.3. Procedures

2.3.1. Randomization

Using a computer generated random table, 65 children were randomly assigned to two intervention groups (with 33, 32 for the exercise and control group respectively). Participants were called back and informed of their designated group once randomization was completed.

2.3.2. Warm-up sessions

Prior to the formal intervention session, participants were given opportunities to practice using treadmill and Wii equipment during the warm-up sessions. Each participant spent about 10 minutes on each piece of equipment. This session was helpful in teaching the participants the correct procedure to carry out the physical fitness exercises.

2.3.3. Intervention sessions

The research group was enrolled in a 10-week intervention program consisting of three 50-minutes sessions per week. The intervention program was conducted on an individual basis in a specially designated space in the university and facilitated by the caregivers/staffs/teachers familiar with the participants. The caregivers/staff/teachers were supervised by a senior occupational therapist with expertise in working with children and who was familiar with the Wii system. Home programs were not provided to the parents or caretakers to minimize possible confounding due to practice effects and variations of treatment techniques between therapists and parents. The 50-min exercise program has two major components: 10-min treadmill exercise (Lotan et al., 2004; Lotan, Isakov, & Merricj, 2004) and 30-min VR-based exercise program with 10-min breaks in between. The Sunpro Treadmill Model 005 was used for treadmill exercises, the children began walking at an average initial speed of 3.3 kph and ended at an averaged speed of 4.1 kph (with 5º of elevation degree). Maximal pulse was recorded at the end of the session.

Nintendo Wii gaming technology provided game-like exercise for the 30-min VR-based exercise program (Wuang, Chiang, Su, & Wang, 2011). At each session, the therapist encouraged the participants to choose their preferred activities from 30 Wii Sports items. These 30 Sports items were previously tested on 10 typically-developing children with the same age of our participants; 55%-70% of the maximal heart beats/minute was reached after using for 30 minutes. Most virtual game simulations require gross movement of the extremities and continuous postural control to accomplish the task. A moderate to high level of physical activity is necessary for the games used in this study. Video games may induce photosensitive seizures (1/40,000) (Fisher, Harding, Erba, Barkley, &Wilkins, 2005) and repetitive motion injuries (Bonis, 2007). The primary investigator monitored the participants for symptoms suggesting seizures or body pain, and stopped the session as soon as the participant felt unwell. No aversive responses of the participants were present throughout the whole study period.

Another two pediatric occupational therapists, who were blind to child group status, administered the measures of physical fitness to the children at pre-and post-therapy (within a week before and after the intervention) according to standardized procedures. For the EEI and THBI, the resting heart rate was measured for 30 min while the participants were seated, in an air-conditioned room with the temperature kept at 25ºC. After the resting heartbeat was measured, the participants took a 12 min walk at their comfortable pace to complete the Cooper test. To decrease possible experimenter bias, the examiner did not reacquaint herself with the child's scores from the first assessment when conducting the retest. Children in the intervention groups were tested at the occupational therapy unit, whereas children in the no-treatment control group were tested in a quiet classroom at the children's respective schools or facilities. The testing was conducted on an individual basis in one session.

2.4. Data analysis

SPSS 15.0 was used to analyze the data. A series of analyses of covariance (ANCOVAs) was performed to compare post-intervention differences in physical fitness measures between the control and the exercise group, using the pretest score as a covariate. In order to quantify the magnitude of the post-intervention difference between intervention and control groups, effect sizes (ES) were calculated as d = (treatment mean -control mean) /*SD*. As a guide to interpreting these values, Cohen (1988) labeled an effect size 'small' if $0.2 \leq ES < 0.5$, 'moderate' if $0.5 \leq ES < 0.8$, or 'large' if $ES \geq 0.8$.

3. Results

Sample demographics are presented in Table 1. There is no difference of the mean age for the exercise (10.6 ± 1.2; range = 9.4 to 11.0 years) and the control group (11.2 ± 1.5; range = 9.3 to 11.2 years). Twenty percent of the participants were obese (BMI over 27), and an additional 52.3% were overweight (BMI over 24). All the demographic attributes were evenly distributed between the two groups.

Table 1
Sample demographics

Demographic	Exercise (n = 33)		Control (n = 32)		Total (n = 65)	
	Mean[a]	*SD*	Mean	*SD*	Mean	*SD*
Age (years)	10.6	3.2	11.2	3.5	10.7	3.4
Height (M)	1.3	.1	1.3	.1	1.3	.1
Body weight (Kg)	52.2	10.2	50.8	9.9	51.0	9.3
BMI	29.5	8.8	30.2	7.6	29.9	10.3
Normal (≥ 24, < 27)	6	18.2	7	21.9	13	20.0
Overweight (≥ 24)	18	54.5	16	50.0	34	52.3
Obese (≥ 27)	9	27.3	9	28.1	18	27.7
Gender (n, %)						
Female	18	54.5	16	50.0	34	52.3
Male	15	45.5	16	50.0	31	47.7
Family annual incomes (NTD)	560,000	131,820	554,550	122,880	557,100	129,700

Note. BMI, body mass index; NTD, national Taiwan dollar.
[a]Or *n* and percentage when indicated.

Table 2 presents mean and standard deviations (*SD*) for the pre- and post-exercise outcomes by designated group along with the *F* tests for each outcome measure. The ANCOVA revealed a significant group effect on cardiovascular function, strength, and body composition. Moderate to large effect sizes (*d*) were obtained for all physical fitness measures as well (0.60 to 0.95).

3.1. Cardiovascular function

The treatment group significantly outperformed the control group in cardiovascular function. Significant group differences were observed for the following outcome measures: Cooper ($F_{1,63}$ = 271.98 , p < .01, d = 0.95); EEI ($F_{1,63}$ = 8.80, p = 0.004, d = 0.60); and THBI ($F_{1,63}$ = 52.14, p < .00, d = 0.63).

Table 2
Physical fitness measures by experimental and pre-posttest condition

	Pretest				Posttest				
	Exercise group		Control group		Exercise group		Control group		Effect size
	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	
Cardiovascular									
Cooper Test	509.4	87.5	500.3	88.2	588.7	97.0	499.9	93.2	0.95*
EEI	3.3	1.1	3.0	1.5	2.5	0.9	3.1	1.0	0.60§
THBI	10.2	6.3	9.7	6.6	5.8	5.3	9.1	5.2	0.63§
Body strength[a]									
Standing long jump	5.0	1.2	5.0	1.3	7.0	1.8	4.0	1.5	-
Push-ups	3.0	1.0	3.0	1.1	3.0	1.1	3.0	1.3	-
Sit-ups	4.0	1.3	4.0	1.0	6.0	1.5	4.0	1.6	-
Wall sit	4.0	1.4	4.0	0.9	5.0	1.5	3.0	1.2	-
V-up	3.0	0.8	3.0	0.8	4.0	1.0	3.0	1.2	-
Total strength score	11.0	6.3	11.0	5.9	16.0	6.6	10.0	6.8	0.88*
Body composition									
Body weight	52.2	7.2	50.8	5.9	49.8	6.6	51.3	6.0	0.25ɳ
BMI	29.5	8.8	30.2	7.6	27.2	4.5	30.8	4.7	0.77§

Note. EEI, energy expenditure index; THBI, total heart beat index; *SD*, standard deviation.

[a]Strength and agility composite of the BOT-2; effect size was not calculated for each subtest of BOT-2 strength and agility composite since they were not standard scores.

*indicates large effect size (ES ≥ 0.8).

§indicates moderate effect size (0.5 ≤ ES < 0.8).

ɳ indicates small effect size (0.2 ≤ ES < 0.5).

3.2. Strength

The initial mean strength score was 11 for both groups. Following the intervention, these scores increased to 16 for the exercise group and decreased to 10 for the control group, respectively. A significant difference ($F_{1,63}$ = 144.03, p = .02, d = 0.88) was found when comparing the pre–post measurements on the BOT-2 SA composite for the whole research group (Table 2).

3.3. Body Composition

A significant difference between treatment and control group was found on both body weight ($F_{1,63}$ = 4.99 , p = .03, d = 0.25) and BMI ($F_{1,63}$ = 35.74 , p = .01, d = 0.77).

4. Discussion

To our knowledge, this is the first study to demonstrate significant gains in physical fitness in a controlled study involving a cohort of school-aged children with DS. Several previous training conducted in individuals with ID reported similar and conflicting findings. Varela, Sardinha, and Pitetti (2001) proposed a training program for 16 adults with DS (8 experimental, 8 controls). The training regimen was a 16-week, 3-day per week program using a rowing machine. This program obtained increases in work performance including time on graded exercise test and work level attained, but improvement in peak VO_2 (cardiovascular function) were not found. Rimmer, Heller, Wang, and Valerio (2004) developed a training program for 52 adults with DS (30 experimental, 22 controls). The training program consisted of 30-min cardiovascular and 15-min strength exercise, 3 days a week for 12 weeks. The training group improved significantly in cardiovascular fitness, muscle strength and endurance and had reduction in body weight comparing to the control group.

A short-term daily treadmill exercise conducted by Lotan et al. (2004) produced significant improvements in physical fitness and functional ability for children with ID after 2 months. Serious studies conducted by Lotan et al. (2009, 2010) incorporated the virtual reality based activity into the regular exercise programs and also demonstrated improvement in physical fitness for individuals with developmental disabilities and ID.

Children with DS have been reported to participate less in physically-based activities (Wuang & Su, 2012). Sedentary lifestyle might trigger the development of obesity, which may lead to a self-perpetuating vicious circle of less activity, low energy expenditure and limited life style (Furija & Fitzsimmons, 1997; Jobling, 2001). Physical fitness is also a strong indicator of health and associated with a lower risk of certain chronic conditions and a higher level of functional independence (Brill, Macera, Davis, Blair, & Gordon, 2000). The unique medical needs and physical features (e.g. lax ligament and joint looseness) of DS affect physical fitness programming and implementing (Dunn, 1997). However, given properly trained therapists and adapted physical educators with progressive attitudes, it is possible that significant gains will be made by DS individuals in the overall physical fitness level and performance.

The present study has some clinical implications. First, the findings of significant gains in general physical fitness are noteworthy given the relatively short-period of the intervention (10 weeks). It is reasonable that a longer intervention might result in greater gains in physical fitness for DS. The study also found that non-trained persons who were supervised by therapist could provide children with DS a physical training program, thus reducing the cost of such intervention and enabling the execution of a low-cost high-frequency program. Such program can be provided in addition to regular occupational therapy intervention and might enhance the effects of rehabilitation intervention (Lotan et al., 2004).

Due to specific challenges presented by children with DS, especially low motivation and reduced accessibility to physical activity program, traditional training programs that provide only fitness routines or remedial-type instruction are not sufficiently motivating (Gignac, 2003). As a consequence, a key element in involving children with DS in exercise programs is to use attractive and reinforcing activities. The VR-based activities used in the present study seem to simultaneously enhance motivation for cooperation, amusement for participation and provide the opportunities for vigorous physical activities in children with DS.

Although maximal exercise testing is considered the gold standard for assessing aerobic capacity, the role of such testing is limited when applying to children with cognitive disabilities due to poor compliance. Sub-maximal exercise testing used in this study such as the THBI (Hood et al., 2002), the EEI (Piccinini et al., 2006; Sawatzky & Denison, 2006) and the modified Cooper test (McGavin et al., 1976) were proved in evaluating physical fitness levels of individuals with DD. These measures overcome many of the limitations of maximal exercise testing, and were found to be the method of choice for clinicians as well as field researchers when working with individuals at the level of mild to moderate level of ID (Lotan et al., 2009).

This study has several limitations. First, most of the participants are in the moderate ID range classified by the DSM-IV criteria (mean WISC-IV score was 51.2). Therefore, generalizing results to groups with severe and profound ID should be cautiously done. Second, we did not monitor if participants take part in any related physical exercise or VR-based activities in addition to the intervention program. Future study should advise the primary caregivers to maintain a diary of child's daily activity. Thirdly, the researcher should further explore whether the child's medications, treatments or paramedical therapies have effects on the training programs. Finally, based on the ethics, the control group should be provided with similar physical fitness training program after the cessation of this study.

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職能治療學會雜誌
民國 101 年 30 卷第 1 期頁 68-86

增進唐氏症兒童體適能之研究

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摘要

研究顯示唐氏症兒童體適能表現較差，因其認知能力之限制，有效的體適能活動需要能誘發唐氏症兒童參與的動機。本研究的目的為探討體適能活動運用於唐氏症兒童之成效，研究對象為65位唐氏症兒童，隨機分配至實驗組（$n = 33$；平均年齡 = 10.6 ± 3.2）及控制組（$n = 32$；平均年齡 = 11.2 ± 3.5）。實驗組兒童接受10週、每週三次體適能活動訓練。體適能訓練活動內容包括10分鐘的跑步機運動及30分鐘的虛擬遊戲運動。結果顯示，與控制組相較，實驗組在心肺功能，肌肉力量及身體組成均有明顯的進步。短期（10週）的體適能活動可增進唐氏症兒童的體適能，減少因為體適能不佳及缺乏活動而造成的健康問題。

關鍵字：唐氏症，體適能，運動介入方案

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受文日期：民國 101 年 3月 6 日
接受刊載：民國 101 年 4月 19 日

Journal of Taiwan Occupational Therapy Association
2012, 30(1), 87-104

Original article

Movement Performance and Sensory Integration in School-Aged Children with Learning Disabilities

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Abstract

The purpose of the study was to describe sensorimotor profile in children with learning disabilities (LD). Seventy children with LD aged 7 to 12 years (mean age = 9.8 ± 2.2 years), were compared with 70 age-matched typically developing children (mean age = 9.3 ± 2.3 years) with measures of motor, sensory integrative, and visual perceptual functioning. The instruments used were the Bruininks–Oseretsky Test of Motor Proficiency-Second Edition, the Test of Sensory Integration Function, and the Developmental Test of Visual Motor Integration. Sensorimotor dysfunctions were found to be very frequent in children with LD. Children with LD performed significantly less well on all test measures compared to the controls. They had weaker fine motor skills than gross motor skills. Sensory integrative functions and visual perception were impaired as well. Early identification of sensorimotor impairments is essential to prompt early intervention and facilitate better integration into regular school settings.

Keywords: *Sensorimotor function, Learning disabilities, School-age children*

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Received: 29 March 2012
Accepted: 17 April 2012

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1. Introduction

Learning disabilities (LD) is a term that describes a heterogeneous group of disorders that impact listening, speaking, reading, writing, reasoning, math, and social skills (American Psychiatric Association, 2000). LD includes a variety of conditions such as perceptual disabilities, dyslexia, and developmental aphasia. These disabilities are not often associated with a specific neurologic insult. Different studies reported varying incidence figures; the most often given figure is about 4% to 5% of the school population, with higher occurrence in boys (a ration of 4:1) (Shapiro, Church, & Lewis, 2007). Learning disabilities vary in severity and pervasiveness, persist across the lifespan, and are not outgrown or cured by medication, therapy, or expert tutoring.

Most children with LD have average or above-average intelligence and adequate sensory acuity; however, a significant discrepancy exists between the child's academic potential and the academic performance. A child with LD may have disorders of motor function including disorder both of motor skills and motor activity level. Motor skills dysfunction may range from clumsiness, to poor gross and fine motor skills, to dyspraxia, to sensorimotor problems in a number of areas (Hari & Renvall, 2001; Waber et al., 2000). Additionally, children with LD also have difficulty with laterality and directionality concepts featuring sensory integrative disorders (Henderson, Pehoski, & Murray, 2002). The prevalence studies indicate that at least 50% of children with LD are identified with developmental coordination disorder (DCD) (Jongmans, Smits-Engelsman, & Schoemaker, 2003). Ayre's classical work (1972) gained an insight into the sensory integrative functions in LD, more evidence-based researches are needed to validate and update the theory. This relationship between poor motor coordination and LD might also indicate an increased vulnerability of neural network that is responsible for integrating sensorimotor information (Waber et al., 2000).

These sensorimotor deficits in LD children greatly impede the quality and quantity of their participation or performance in activities in school, at home, and in the community (Dolva, Coster, & Lilja, 2004). The role of occupational therapists in an intervention program for the child should therefore focus on the sensory integrative and motor functions to promote social play, academic performance (e.g. writing) and independent living skills. However, motor performance and sensory integrative functions in school-aged children with LD were rarely documented compared to other developmental disabilities such as cerebral palsy (CP) (Steenbergen & Gordon, 2006), autism (Siaperas et al., 2011), and intellectual disabilities (ID) (Wuang, Wang, Huang, & Su, 2008). Characterizing movement and sensory profiles in LD is essential in supporting the future development of approaches to overcoming disturbances in sensorimotor functioning. Therefore, the aim of this study was to simultaneously investigate motor and sensory integrative performance in children with LD.

2. Methods

2.1. Design

The Bruininks–Oseretsky Test of Motor Proficiency-Second Edition (BOT-2) (Bruininks & Bruininks, 2005), the Test of Sensory Integration Function (TSIF) (Lin et al., 2004), and the Developmental Test of Visual Motor Integration (VMI) (Beery, 1997) were used to investigate sensorimotor performance in a group with LD and an age-matched control group. Overall performance on sensorimotor measures (relative to standardized scores) was compared between the LD and the control participants.

2.2. Participants

Seventy children aged 6–12 years with LD were recruited together with 70 age-matched typically developing children (TD) by contacting schools and educational authorities in southern Taiwan and by placing a notice on the website. Identification of children for the group with LD was defined according to but not limited to standards set forth by the Ministry of Education in Taiwan (2009), including (1) standardized scores of full intelligence quotient (FIQ) $\geqq$ 85 on WISC–III or WISC-IV;

(2) reading comprehension scores and arithmetic computation scores at or below the 25th percentile in his/her class; (3) no indication of brain injury as documented by student records; and (4) identification of a learning disability by a multidisciplinary diagnostic assessment team. Exclusion criteria included diagnosis of developmental coordination disorder (DCD), severe sensory abnormalities and evidence of ID. At least one parent of each participant consented before the study started.

The mean age for the LD group and the control group was 9.8 (*SD* = 2.2) and 9.3 (*SD* = 2.3) respectively. Of the 140 children, 41 were girls and 99 were boys. Gender representation was not significantly different between the two groups ($x^2 = 0.26$, $df = 1$, $p = .29$).

2.3. Assessments

2.3.1. The Bruininks–Oseretsky Test of Motor Proficiency-Second Edition (BOT-2)

The BOT-2 assesses proficiency and skills in four motor-area composites. Fine manual control composite (FMC) is divided into fine motor precision (FMP) and fine motor integration (FMI) subtests that measure the motor skills involved in tasks requiring precise control of finger and hand movements. Manual coordination composite (MC) is classified into manual dexterity (MD) and upper-limb coordination (ULC) subtests that evaluate speed, dexterity, and coordination of upper extremities movements. Body coordination composite (BC) is grouped into bilateral coordination (BLC) and balance (BAL) subtests that tap the balance and motor skills required for successful participation in sports and recreational games. Strength and agility composite (SA) is split into running speed and agility (RSA) and strength (STR) subtests that assess large muscle strength, running speed, and postural control during walking and running. The four composite scores are combined to yield a total motor composite score. The age-adjusted standard score for subtests and five composites are 15 (*SD* = 5) and 50 (*SD* = 10) respectively. For the composites, internal consistency reliability coefficients ranged from .78 to .97, test–retest coefficients ranged from .52

to .95, and inter-rater reliability coefficients exceeded .92 (Bruininks & Bruininks, 2005). The BOT-2 total composite correlated fairly well with other measures of motor performance such as the Peabody Developmental Motor Scales, Second Edition (Folio & Fewell, 2000) and the Test of Visual Motor Skills-Revised (Gardner, 1995) (.62 and .73 respectively).

2.3.2. Test of Sensory Integration Function (TSIF)

The TSIF is designed to identify sensory integrative dysfunction in children aged from 3 through 12 years. Sensory integration refers to the neurological process that organizes sensation from one's own body and from the environment and makes it possible to use the body effectively within the environment (Ayres, 1972). When the sensory inputs from visual, auditory, vestibular, proprioceptive, and tactile systems are not integrated or organized appropriately in the brain, varying degrees of problems in development, information processing, and behavior may occur. The test consists of 98 items divided into seven subtests: postural movement, bilateral integration sequencing, sensory discrimination, sensory modulation, sensory searching, attention and activity, and emotional–behavioral reactivity. These subtests are made up of interactive activities that engage multiple sensory systems, including vestibular, proprioceptive and tactile systems. Each of the items is rated on a 5-point Likert scale from 1 = never to 5 = always, based on the frequency of targeted behaviour during the entire observation. The age-adjusted standard score for subtests are 50 (*SD* = 10). The psychometric properties were well established by the test authors (Lin et al., 2004). Internal consistency for the overall test demonstrated a Cronbach's alpha of .89, whereas test–retest reliabilities for the subtest scores ranged from .82 and .94. The TSIF subtest scores significantly varied as a function of age, gender, and residential location (urban versus rural) (Lin et al., 2004).

2.3.3. Developmental Test of Visual Motor Integration (VMI)

The VMI is a paper-and pencil task used to assess a child's graphomotor or handwriting skills, which require both visual perception and motor planning abilities. The test involves copying a developmental sequence of 27 geometric forms. The VMI has two supplemental subtests: visual perception and motor coordination. The visual perception task requires the child to choose a geometric form identical to the stimulus form among others that look nearly but not exactly the same. In the motor coordination task, the child has to trace the same 27 geometric forms with a pencil without going outside the double-lined paths. Higher scores indicate better performance. Published standard scores of the VMI as well as supplemental tests have a mean of 100 and a standard deviation of 15. The VMI demonstrated overall good reliability (Beery, 1997). Test-retest reliability correlation .87 was obtained from kindergarten to high school children in Taiwan over a four-month period while inter-rater reliability coefficients for two scorers was .93 (Liu & Lu, 1998). In terms of validity, the VMI correlated highly with chronological age (.80 - .90), and with other tests that purport to measure visual-motor integration (Erford & Snyder, 2004).

2.4. Procedure

The study was conducted during 2011–2012 after approval by the Institutional Review Board of the Kaohsiung Medical University. Children with LD were identified from thirty-six urban and rural elementary schools located in southern Taiwan. Each participant was assessed in a quiet classroom at the children's respective schools. The testing was conducted on an individual basis in one session lasting approximately 1 to 1.5 hours. Before the testing procedure, every task was explained and participants had one or two practice trials. All participants were assessed on the BOT-2 test first and then the TSIF, and the VMI. During the testing procedure, all participants had two breaks of 10 minutes each.

2.5. Data analysis

To facilitate analyses, all raw scores were converted to standard scores using the publisher-provided norms. A one-sample *z*-test was first computed to evaluate whether children with LD performed differently from age-based normative samples for the BOT-2, TSIF, and VMI. In order to investigate the difference on sensorimotor performance between the groups (LD vs. TD), scores from these three measures were analyzed using multivariate analysis of variance (MANOVA). Significance levels were set at $p < .05$ throughout.

3. Results

3.1. Profile of sensorimotor functions

Results of *z*-tests revealed significant impairment across most test measures in children with LD (Table 1). The number of impaired scores demonstrated by individual children among 22 measures of sensorimotor functions is presented in Table 2. All children showed impaired performance on at least four test measures. Forty-one (58.6%) children had sensorimotor impairment clustered between 5, 6 and 7 sensorimotor subtests, whereas 20/70 (29%) had results falling 1.0 *SD* below the mean on 8 or more subtests. Children's performance on motor, and sensory integration tests were described as follows.

3.2. Motor profile

Table 3 shows that control participants scored higher on BOT-2 overall (p = .01, $F_{1,138}$ = 368.81). A MANOVA showed a statistically significant difference between groups by BOT-2 domains: $F_{4,135}$ = 795.83; p = .001; Wilk's Lambda = 0.04; partial η^2 = .90). Considered separately, results for the dependent variables demonstrated significantly impaired performance on each of the constituent composites of the BOT-2 compared to the control group (Bonferroni adjusted, for Fine Manual Control, $F_{1,138}$ =

969.3; Manual Control, $F_{1,138}$ = 525.4 ; Body Coordination, $F_{1,138}$ = 75.87 and Strength and Agility, $F_{1,138}$ = 201.32, respectively) . Children with LD have impaired performance on all the BOT-2 subtests and composites (z < -1.65), and they consistently performed better on assessments of GM than FM skills (Table 1).

Table 1

Z-tests on the standard scores of the BOT-2, TSIF, and VMI for children with learning disabilities (n = 70)

Tests	Impairment[a] *n*(%)	*Z*-test statistic[b]
BOT-2		
Fine motor precision	19 (27.1)	-10.67
Fine motor integration	30 (42.9)	-11.22
Manual dexterity	35 (50.0)	-12.17
Upper-limb coordination	11 (15.7)	-5.72
Bilateral coordination	6 (8.6)	-6.42
Balance	6 (8.6)	-5.26
Running speed & agility	8 (11.4)	-6.48
Strength	5 (7.1)	-5.51
Fine manual control composite	39 (55.7)	-20.12
Manual coordination composite	28 (40.0)	-12.26
Body coordination composite	12 (17.1)	-9.18
Strength and agility composite	6 (8.6)	-0.87
Total motor composite	50 (71.4)	-20.16
TSIF[c]		
Postural movement	0	0.72
Bilateral integration sequencing	10 (14.3)	0.38
Sensory discrimination	12 (17.1)	-0.09
Sensory modulation	8 (11.4)	-0.12
Sensory searching	0	1.44
Attention and activity	12 (17.1)	-0.11
Emotional-behavioral reactivity	0	1.02
VMI		
Visual perception test	30 (42.9)	-33.54
Motor coordination test	29 (41.4)	-42.03
Total score	30 (42.9)	-26.12

Note. BOT-2, Bruninks-Oseretsky Test of Motor Proficiency, Second Edition; TSIF, Test of Sensory Integration Function; VMI, Developmental Test of Visual Motor Integration.

[a]Impairment was defined as performance equal to or more than 1 *SD* below normativemeans on sensorimotor measures.

[b]p < .0001 for all z values.

[c]Lower scores indicate better performance.

Table 2
Number of impaired subtests and percentages of children with learning disabilities demonstrating impairment (n = 70)

No. of tests impaired	Frequency of impairment, n(%)[a]
0	0
1	0
2	0
3	0
4	9 (12.9)
5	10 (14.3)
6	15 (21.4)
7	16 (22.9)
8	15 (21.4)
9	5 (7.1)

Note. [a]Sensorimotor impairment was defined as performance equal to or more than 1.0 *SD* below normative mean on a test measure.

3.3. Sensory integration profile

Table 3 indicates that control participants scored higher than the LD group on five of seven aspects of TSIF. Analysis using MANOVA confirmed that these differences were statistically significant (Bonferroni adjusted; postural-ocular movement, $F_{1,138}$ = 22.01; bilateral integration sequencing, $F_{1,138}$ = 567.31; sensory discrimination, $F_{1,138}$ = 329.89; sensory modulation, $F_{1,138}$ = 354.19; and attention and activity, $F_{1,138}$ = 733.86). Children with LD showed no impairments on TSIF subtest ($z > -1.65$). They performed best on the postural ocular movement and sensory searching, but performed worst on the attention and activity level, sensory discrimination, and sensory searching tasks (Table 1). The TD group outperformed the LD group on the VMI total and 2 supplement subtests. With reference to frequency of visual perception impairment, more than 40% children scored in the impaired range on all subtests of the two VMI supplemental tests (Table 1).

Table 3
Summary of the sensorimotor measures for each group

Measures	Mean (*SD*)		*F*	Partial η^2
	LD group (n = 70)	Controls (n = 70)		
BOT-2				
Fine motor precision	10.0 (1.7)	15.1 (1.5)	323.77*	.70
Fine motor integration	9.9 (1.9)	15.4 (1.7)	326.07**	.70
Manual dexterity	9.3 (1.9)	14.9 (1.5)	384.47*	.74
Upper-limb coordination	11.7 (2.2)	15.4 (1.7)	206.75*	.60
Bilateral coordination	11.8 (1.9)	15.0 (1.5)	204.95*	.60
Balance	14.9 (1.9)	15.6 (1.9)	4.42	.03
Running speed & agility	11.6 (1.7)	15.2 (1.7)	266.99**	.66
Strength	14.7 (2.0)	15.0 (1.5)	0.61	.00
Fine manual control composite	32.8 (4.2)	50.3 (2.1)	969.34*	.88
Manual coordination composite	37.8 (4.2)	50.4 (2.0)	525.44*	.79
Body coordination composite	47.7 (4.2)	50.6 (2.4)	35.87*	.36
Strength and agility composite	42.8 (3.9)	50.7 (2.4)	201.32*	.59
Total motor composite	33.7 (4.2)	51.2 (2.1)	887.62*	.87
TSIF				
Postural-ocular movement	36.6 (2.4)	33.7 (4.8)	22.01*	.14
Bilateral integration sequencing	52.3 (2.1)	38.6 (4.4)	567.31*	.81
Sensory discrimination	52.4 (2.1)	41.5 (4.6)	229.89*	.71
Sensory modulation	52.2 (2.1)	42.5 (3.8)	354.19**	.72
Sensory searching	37.0 (10.1)	34.4 (4.5)	18.56	.03
Attention and activity	52.5 (2.0)	38.3 (3.9)	733.87*	.88
Emotion and behavior	40.1 (4.0)	38.4 (4.0)	3.17	.00
VMI				
Visual perception test	54.6 (4.2)	76.6 (3.5)	1307.36*	.67
Motor coordination test	59.4 (3.6)	72.4 (4.0)	1156.99*	.73
Total score	68.3 (3.4)	74.1 (2.9)	659.95*	.42

Note. BOT-2, Bruninks-Oseretsky Test of Motor Proficiency, Second Edition; TSIF, Test of Sensory Integration Function; VMI, Developmental Test of Visual Motor Integration.
$^{*}p < .05$. $^{**}p < .01$.

4. Discussion

In the present study, validated instruments were used to describe the patterns of motor performance and sensory integration functions in a group of children with LD compared to a control group comprising age-matched typically developing children (TD). The results indicated that LD group had significant impairments across most sensorimotor functions measured in addition to their academic learning deficiencies. Besides, these sensorimotor impairments seem to persist into later childhood (10-12 years). Using a cut-off of 1.0 *SD*, all children performed below this threshold on 4 or more among the 22 sensorimotor tests. Fifty-nine percent of the LD children had sensorimotor impairment clustered between 5, 6 and 7 subtests. Children with LD are often less motivated to actively explore the environment and, in turn, will receive few sensory inputs which are likely to further exacerbate motor difficulties in this population (Smits-Engelsman, Wilson, Westenberg, & Duysens, 2003).

The impaired motor performance revealed in the BOT-2 scores echoed the previous studies that children with LD might have poor motor functioning (Fletcher, Lyon, Fuchs, & Burnes, 2007; Stordy, 2007). For the group as a whole, gross motor performance was better than fine motor skills. This disparity can also be seen in other developmental diagnoses such as ID, CP, William's syndrome, ADHD, and DCD (Charlton, Ihsen, & Lavelle, 2000; Bellugi, Lichtenberger, Jones, Lai, & St. George, 2000; Fedrizzi, Pagliano, Andreucci, & Oleari, 2003; Wuang et al., 2008). A proposed explanation for fine and gross motor skills discrepancy in children with disabilities is that components of fine motor skills, such as precision grip, in-hand manipulation, and tool use, exert greater demand on the maturity and integrity of the central nervous system, especially frontoparietal network (Davare, Andres, Cosnard, Thonnard, & Olivier, 2006).

The current study results showed that LD children also displayed sensory integrative dysfunction, particularly in the areas of sensory discrimination and bilateral integration sequencing related to somatodyspraxia. Children with somatodyspraxia may rely more on feedback during movement execution and have difficulty switching to feedforward strategy so that they experience obvious difficulty with both self-care and academic performance (e.g. handwriting and drawing). Additionally, impairment in processing temporal/sequencing sensations could account for some of the perceptual-motor and cognitive symptoms often associated with LD (Habib, 2000). The sensory modulation disorder (SMD) may also contribute to the adaptive behavior deficits of these children and impact on their ability to engage in home, educational, and social activities. Even the score of sensory searching in the LD group were within the normal range; however, the large standard deviation (10.1) might suggest that children with LD have widely varied sensory searching abilities.

Proprioceptive, vestibular processing and tactility have a substantial impact on movement performance; therefore, movement performance in LD may be highlighted by sensory integrative dysfunctions. Participants with LD scored lower in the Fine Manual Control and Manual Dexterity composites of the BOT-2, which are associated with the interpretation of the tactile and proprioceptive information. Moreover, poor performance on the Body Coordination of the BOT-2 might reflect the insufficient vestibular and proprioceptive processing. Also, LD children did not score high on hand-eye coordination when required to move fast and accurately (e.g. the BOT-2 FMI subtests), which may be due to problems with processing fast incoming sensory information, which might suggest intrahemispheric deficit (Sigmundsson, Whiting, & Ingvaldsen, 1999). Further research is needed to explore the causative relations between sensory integration and motor performance in LD.

Academic failure at school may occur partly in consequence of poor visual motor integration tasks (e.g. handwriting), as reflected by the impaired performance on the VMI. Children with bilateral integration sequencing deficits might have more difficulty with spontaneous writing, while children with somatodyspraxia may struggle with both spontaneous writing and letter copying (Reeves & Cermak, 2002). In accordance with previous studies, children with LD may demonstrate impairments in visual-spatial abilities and cognition (Burtner, Qualls, Ortega, Morris, & Scott, 2002; Most & Greenbank, 2000). Spatial errors demonstrated by the LD children include disorganization of the spatial relationship, orientation among the figures, or difficulty with the overall contour (Bouldoukain, Wilkins, & Evans, 2002). The impact of poor manual dexterity and visual-motor integration is not to be underestimated, as a large number of children with LD are likely to pursue vocational training, where these abilities are mandatory. Given that occupational therapists focus on children's participation in education, ADL, and social activities, the focus of the client factor of visual perception and its effects on performance skills (literacy and handwriting) can be critical.

Previous studies have emphasized the perceptual-motor dysfunctions observed in children with combined LD and DCD and it appears that they have particular difficulty performing manual dexterity and balance tasks (Jongmans et al., 2003). However, our study showed somewhat different results in that LD children had no significant difficulty in performing balance tasks comparing to TD controls. Nevertheless, the severity of perceptual-motor dysfunctions indeed increase and necessitate more intensive treatment if LD children have accompanying motor and sensory integrative dysfunctions.

We suggest that poor sensorimotor performance may exacerbate the reduced opportunities for social inclusion experienced by individuals with LD, as typically developing children are reported to value performance in sports more than for example, academic performance (Nikitaras & Ntoumanis 2003; Chase & Machida, 2011). Individuals with LD could be at greater risk of being bullied because of low self-esteem, anxiety in social settings, lack of confidence and limited success in sports (Mishna, 2003) . This clearly will impact on physical health and underlines the importance of addressing sensorimotor difficulties. As a consequence, successful interventions should contain approaches aimed at improving the fundamental sensorimotor functions to increase the likelihood of success.

In conclusion, our study suggested that children with LD have sensorimotor impairments in addition to their deficits in academic learning. Increasing our understanding of these impairments could have treatment implications for those supporting individuals with LD.

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職能治療學會雜誌
民國 101 年 30 卷第 1 期頁 87-104

原著

學習障礙兒童動作及感覺統合功能之探討

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摘要

本研究之目的為探討學習障礙兒童之動作表現及感覺統合功能。70位學習障礙兒童（平均年齡＝9.8 ± 2.2）和70位正常發展兒童（平均年齡＝9.3 ± 2.3）接受動作功能、感覺統合及視知覺功能之評估。結果顯示感覺動作問題常見於學習障礙兒童，學習障礙兒童所有的動作表現均較控制組差；此外，學習障礙兒童的精細動作功能較粗大動作功能差。學習障礙兒童也呈現感覺統合與視知覺功能失常。針對感覺動作功能早期的評估及介入可幫助學習障礙兒童更能融合至一般的學習情境中。

關鍵字：學習障礙，感覺統合，動作功能

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受文日期：民國 101 年 3月 29 日
接受刊載：民國 101 年 4月 17 日

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投稿須知

一、『職能治療學會雜誌』為台灣職能治療學會所發行一年兩期的專業學術期刊。本雜誌設有嚴謹的同儕審查制度，凡與職能治療有關之學術論述，且未曾發表於其他刊物，皆為本雜誌刊載之對象。本雜誌亦收錄由台灣職能治療學會主辦的學術研討會所發表的論文摘要以及學會各委員會執行學會或政府機構委辦之研究計畫結案報告。

二、來稿以中文或英文格式撰寫均可。投稿類型包括原著(original articles)、個案報告 (case reports)、專題 (special reports)、文獻評論 (review articles)、簡報 (brief reports)與致編者函 (letters to the editor)。

三、**原著：**係指實證性研究論述。中文稿件字數 (含參考文獻與圖表)以不超過15,000字為原則。英文稿件字數以不超過5,000字(不含參考文獻與圖表)為原則。

個案報告：中文稿件字數(含參考文獻與圖表)以不超過6,000字為原則。 英文稿件字數以不超過2,000字(不含參考文獻與圖表)為原則。

專題：職能治療領域值得深入探討的特別邀請專題。中文稿件字數(含參考文獻與圖表)以不超過15,000字為原則。英文稿件字數以不超過5,000字(不含參考文獻與圖表)為原則。

文獻評論：針對特定主題作完整之文獻回顧與客觀討論。中文稿件字數(含參考文獻與圖表)以不超過15,000字為原則。英文稿件字數以不超過5,000字(不含參考文獻與圖表)為原則。

簡報：指初步的研究結果或臨床上、技術上的精簡論述。中文稿件字數以 不超過5,000字為原則(含參考文獻與圖表)。英文稿件字數以不超過1,500字(不含參考文獻與圖表)為原則。

致編者函：中文稿件字數以不超過1,000字為原則；英文稿件字數以600~800字為原則。中英文稿的文獻以 10 筆為上限，圖或表至多 1 個。

四、惠稿請附上「申請投稿聲明書」 (自行選擇由通訊作者代表簽名或全體作者簽名)，並將稿件以電子郵件方式寄至 cysu@cc.kmu.edu.tw；信件主旨請註明「職能治療學會雜誌投稿」。請依本刊撰稿體例投稿，**格式不符與字數超過者將逕予退回修正。**

五、審稿程序

1.預審：主編依據是否符合本刊之性質以及文章的嚴謹程度決定是否送初審。

2.初審：稿件將聘請兩名文章所屬領域的專家學者進行雙向匿名審查。凡審稿者建議「修正後再送審查」之文稿，作者需將修改後之稿件(以紅色標示修改處)，連同「審查意見回應表」以電郵方式寄回本刊交由原審查者進行複審。初審結果將於收到稿件四週內完成並通知作者。

3.複審：凡審稿者建議「修正後再送審查」之文稿，作者需將修改後之稿件(以紅色標示修改處)，連同「審查意見回應表」以電郵方式寄回本刊交由原審查者進行複審。複審結果將於收到稿件三週內完成並通知作者。

4.若需延期交稿者，需以書面通知本刊並說明原因。未能於規定期限內修改寄回者將視同撤稿。

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七、在本雜誌刊登之著作，其著作權屬於本會，除商得本會書面同意外，不得轉載於其他雜誌或媒體。

八、經刊登之論文，本雜誌將贈送每位作者當期期刊一本及論文之PDF電子檔，如需抽印本可自費印刷。

九、中英文稿件原則：

1. 稿件格式：採用《美國心理協會出版手冊》第六版 (Publication Manual of the American Psychological Association, 6th ed., 2009) 格式。中英文部份略作修改，未及規範之處，以該手冊第六版為依據。
   (1)稿件應隔行打字於A4紙上，每頁上、下、左、右至少留白2.54公分。
   (2)字型：中文請統一用**標楷體**；英文請統一用**Times New Roman**。字體大小請採12級字，每頁列有重新編碼之行號，以利排版及審稿。
   (3)行距：統一為**兩倍行高**。
2. 作者如超過六人，請註明個別作者在文章的貢獻部分。
3. 稿件內容架構：封面頁、中英文摘要、本文、誌謝、參考文獻、表格與圖。
4. 稿件應按下列順序分頁書寫，並請編頁碼於稿紙右上方，整理後提出。

封面頁：含作者姓名、執行該研究時服務單位，通訊者姓名、地址、電話及電子信箱（上半頁列中文資料，下半頁列英文資料，如為英文稿件則相反）。著者屬不同機構或單位，其中文書寫形式如下列：

羅鈞令1　楊國德2,＊

臺灣大學醫學院職能治療學系1　　中山醫學大學職能治療學系2

英文書寫型式如下例：

Jin-Ling Lo[a], Kuo-Te Yang[b,*]

[a]School of Occupational Therapy, College of Medicine, National Taiwan University, Taiwan

[b]School of Occupational Therapy, Chung Shan Medical University, Taiwan

第一頁： 中英文題目（英文題目中，除了小於4個字母的連接詞、冠詞和介系詞外之第一個字母請大寫）及中文20個字（或英文40個字母）以內的逐頁標題（running title）。

第二頁：中文摘要不超過五百字及至多5個中文關鍵詞。各關鍵詞之間以「，」區隔，句末不加「。」。**請在頁末註明字數**。

第三頁：英文摘要不超過 250 字及至多 5 個英文關鍵詞。**請在頁末註明字數**。

第四頁以後：本文、誌謝、參考文獻及圖表。

本文：稿件應包括前言 (Introduction)、研究方法 (Materials and methods)、結果 (Results)與討論 (Discussion)。請在討論部分的末頁註明字數。中文稿件的第一階標題請使用16pt標楷體，粗體，置中；第一階標題編碼請使用國字壹、貳、參等，如**壹、前**言。第一及第二階標題與前段內文間均請空一行，第三階標題則不需空行。第二階標題請使用14pt標楷體，粗體，靠左對齊。第二階標題編碼請使用國字一、二、三等。第三階標題請使用12pt標楷體，粗體，靠左對齊。第三階標題編碼請使用有括弧的國字(一)、(二)、(三)等。英文稿件的第一階標題請使用16pt Times New Roman，粗體靠左對齊。第一階標題編碼請使用1, 2, 3

等，如**1. Introduction**。第一及第二階標題與前段內文間均請空一行，第三階標題則不需空行。第二階標題請使用 14pt Times New Roman，斜體靠左對齊。第二階標題編碼請使用1.1., 2.1., 3.1. 等。第三階標題編碼請使用12pt Times New Roman，斜體靠左對齊。第三階標題編碼請使用1.1.1., 2.1.1., 3.1.1. 等。

5. 統計符號請以斜體字標示，如：t-檢定。度量衡單位採用國際單位系統符號。
6. 圖表：圖表數目請儘量精簡。每一圖或表應分別繕打於稿紙上。圖片應為黑白光面照片、黑白正片或以黑色筆繪製。圖片下方應註明圖號與圖名，表格上方應註明表號及表名，中文手稿應以中文說明為主（格式請參考美國心理協會出版手冊第六版）。
7. 本文引證格式：中文文獻作者為一人時，註明為姓名(民年代）或 (姓名，民年代)。當所引證文獻的作者為兩人時，兩人之姓名每次引證均需全部列出，中間以「與」字連接（見例一）；若為圓括弧中引證則以頓號（、）來連接（見例二）。若作者為三至五人，第一次引證時所有作者姓名須悉數列上，嗣後再引證時則只列第一作者姓名，後加「等」字代替其他作者。若作者為六人以上（含六人）時，則第一次和後續引證都只需列出第一作者，其後以「等」字表示。英文寫法請參見例四。在文末所附之參考書目中亦僅列出前六位作者。外文文獻格式請依據美國心理協會出版手冊第六版。

   範例：◎ 例一：張彧與李文淑（民 83）提到……

   ◎ 例二：教育局支持在數個國小進行感覺統合療效研究計畫（羅鈞令、姚開屏，民 75）

   ◎ 例三：美國心理協會（1994，1997）規定論文寫作……
   註：閱讀的是中譯本，1994是原著出刊年，1997是譯本之出版年。

   ◎ 例四：Kosslyn et al. (1992)… 或 (Kosslyn et al., 1992)

   註：當第二次以上引用三至五位作者文獻，或該為六人以上。
8. 參考文獻：文獻應以文內實際提及之原始文獻者為限。中文文獻列於前，依姓氏筆劃遞增排列，筆劃相同依姓名第二字筆劃，以此類推；外文文獻列於後，依姓氏字母順序排列。外文請依美國心理協會出版手冊第六版格式繕寫，中文請參考以下範例。

   ◎期刊— 作者姓名（年份）。篇名。**期刊全稱，期別**，頁碼。

   ◎書籍— 章節作者姓名（年份）。篇名。編者姓名，**書名**（第x版，頁xxx-xxx）。出版地：出版社。

   ◎其他刊物、電子媒體等，請參考手冊。

學會特刊的論文：

李建賢（民 73）。對於我國緊急醫療系統的省思與建旨。**急救加護醫學會特刊，5**，7-9。

學會會報的論文摘要：

張彧、李文淑（民 83）。台灣生理疾患職能治療從業人員媒介使用之探討。**中華民國職能治療學會第十四次學術研討會會報，10**。

單行本：

陳宗瀛、姜必寧（1993）。**臨床心電圖學**，頁1-26。台北：華榮。

Mitchell, T. R., & Larson, J. R. Jr. (1987). *People in organizations: An introduction to organizational behavior* (3rd ed.). New York, NY: McGraw-Hill.

編著書籍的一章：

陳楷模（民65）。腹部急症。載於陳秋江、許書劍 (主編)，**外科急症**（頁5-13）。台北：當代醫學雜誌社。

期刊文章：

顏秀紅（民73）。簡介美國幾家醫院職能治療之近況。**職能治療學會雜誌，2**，79-82。

Shalev, L., & Tsal, Y. (2006). The wide attentional window: A major deficit of children with attention difficulties. *Journal of Learning Disabilities, 36*, 517-527.

翻譯圖書：

美國心理協會(American Psychological Association)(1997)。**美國心理協會出版手冊第四版***（中譯二版）*(Publication manual of the American Psychological Association, 4th ed.)（王明傑、陳玉玲譯）。台北：雙葉。(1994)

（註：1997是譯本之出版年；1994為原著出版年。）

會議及座談會之會議紀錄：

Deci, E. L., & Ryan, R. M. (1991). A motivational approach to self: Integration in personality. In R. Dienstbier (Ed.), *Nebraska Symposium on Motivation: Vol. 38. Perspectives on Motivation* (pp. 237-288). Lincoln, NE: University of Nebraska Press.

七位以上作者：

Clark F., Azen, S. P., Zemke, R., Jackson, J., Carlson, M., Mandel, D., … Heaton, R.K. (1997). Occupational therapy for independent-living older adults. *Journal of American Medical Association, 278*, 1321-1326.

叢書中一卷的一章：

Maccoby, E. E., & Murtin, J. (1983). Socialization in the context of the family: Parent-child interaction. In P. H. Mussen (Series Ed.) & E. M. Hetherington (Vol. Ed.), *Handbook of child psychology: Vol. 4. Socialization, personality, and social development* (4th ed., pp. 1-101). New York: Wiley.

排印中期刊文章：

Zuckerman, M., & Kieffer, S. C. (in press). Race differences in fascism: Does facial prominence imply dominance? Journal of Personality and Social Psychology.

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職能治療學會雜誌

Journal of Taiwan Occupational Therapy

中華民國一O一年六月出刊

第三十卷第一期 Volume 30, Number 1 (June 2012) ISSN 1013-7661

民國七十二年十一月創刊

發行所：台灣職能治療學會　地址：100 台北市博愛路9號5樓之3

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