

Appendix B – Detailed Charts
The Gross Motor Function Classification System: An Update on Impact and Clinical Utility
Laura Gray, Hennie Ng, Doreen Bartlett

Detailed Chart 1. Classification of research studies on the measurement properties of the original GMFCS (N=5)

Authors	Inter-rater Reliability	Validity	Stability	Translation
Gainsborough, Surman, Maestri et al, 2008	X			
Palisano, Rosenbaum, Bartlett et al, 2008		X		
McDowell, Kerr, Parkes, 2007	X			
Papavasiliou, Rapidi, Rizou et al, 2007				X
Palisano, Cameron, Rosenbaum et al, 2006			X	

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Detailed Chart 2. Classification of research studies on the validity of other measurement tools with the GMFCS according to ICF subclassifications⁷ (N=17)

Authors	Body Structure and Function	Activity	Participation	Personal Factors	Environmental Factors	Quality of Life
Gan, Tung, Tang et al, 2008	X	X				
Gilles, Arnould, Thonnard et al, 2008		X				
Vargus-Adams, 2008		X				
Viehweger, Haumont, de Lattre et al, 2008		X				
Wren, Sheng, Bowen et al, 2008	X	X	X			
Bagley, Gorton, Oeffinger et al, 2007	X	X				
Carnahan, Arner, Hagglund, 2007			X			
Waters, Davis, Mackinnon et al, 2007						X
Narayanan, Fehlings, Weir et al, 2006						X
Varni, Burwinkle, Berrin et al, 2006						X
Verschuren, Takken, Ketelaar et al, 2006		X				
Bartlett, Purdie, 2005	X					
McDowell, Kerr, Parkes et al, 2005		X				
Saigal, Rosenbaum, Stoskopf et al, 2005	X	X				
Williams, Carroll, Reddihough et al, 2005		X				
Gorter, Rosenbaum, Hanna et al, 2004	X					
Bartlett, Birmingham, 2003	X					

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Detailed Chart 3. Classification of observational research studies making use of the GMFCS (N=121)

Authors	Sample Descriptor	Association with GMFCS as Outcome	Association with GMFCS with Outcome
Bar-Haim, Belokopytov, Harries et al, 2008	X		
Barnes, Linton, Sullivan et al, 2008	X		X
Bjornson, Belza, Kartin et al, 2008	X		X
Calis, Veugelers, Sheppard et al, 2008	X		X
Carlsson, Olsson, Hagberg et al, 2008	X		
Donnelly, Parkes, McDowell et al, 2008	X		
Enkelaar, Ketelaar, Gorter et al, 2008	X		
Faber, Nienhuis, Rijs et al, 2008	X		
Imms, Reilly, Carlin et al, 2008	X		X*
Gannotti, Gorton, Nahorniak et al, 2008	X		X*
Gates, Otsuka, Sanders et al, 2008	X		
Ghasia, Brunstrom, Gordon et al, 2008			X*
Gough, Shafafy, Shortland et al, 2008	X		
Hurvitz, Green, Hornyak et al, 2008	X		X*
Kecskemethy, Herman, May et al, 2008	X		
Kerr, Parkes, Stevenson et al, 2008	X		X
Ketelaar, Volman, Gorter et al, 2008	X		
Livingston, Rosenbaum, 2008	X		
Majnemer, Shevell, Law et al, 2008 (1)	X		
Majnemer, Shevell, Law et al, 2008 (2)	X		
Mohagheghi, Khan, Meadows et al, 2008	X		
Moreau, Li, Geaghan et al, 2008	X		X
Mutlu, Livanelioglu, Gunel et al, 2008	X		
Ohata, Tsuboyama, Haruta et al, 2008	X		
Pierce, Barbe, Barr et al, 2008			X*

* with GMFCS subgroup analysis

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Detailed Chart 3. Classification of observational research studies making use of the GMFCS (N=121) – continued

Authors	Sample Descriptor	Association with GMFCS as Outcome	Association with GMFCS with Outcome
Redekop, Andrysek, Wright et al, 2008			X*
Robin, Graham, Selber et al, 2008	X		X*
Romeo, Cioni, Scoto et al, 2008		X*	
Roze, Kerstjens, Maathuis et al, 2008	X	X	
Shelly, Davis, Waters et al, 2008	X		X
Shevell, Majnemer, Poulin et al, 2008	X		
Sigurdardottir, Eiriksdottir, Gunnarsdottir et al, 2008	X		
Sorsdahl, Moe-Nilssen, Strand, 2008	X		
Soylu, Unalp, Uran et al, 2008			X
Tedroff, Knutson, Soderberg, 2008	X		
Thompson, Beath, Bell et al, 2008	X		X*
Venkateswaran, Shevell, 2008	X		X*
Wingert, Burton, Sinclair et al, 2008	X		
Aran, Shalev, Biran et al, 2007	X		
Beckung, Carlsson, Carlsdotter et al, 2007			X*
Bjornson, Belza, Kartin et al, 2007	X		X
Brehm, Becher, Harlaar, 2007	X		
Bross, Honeck, Kwon et al, 2007	X		X*
Crompton, Galea, Phillips, 2007	X		
Day, Wu, Strauss et al, 2007	X		
Donkervoort, Roebroek, Wiegerink et al, 2007			X
Feeley, Gollapudi, Otsuka, 2007			X*
Gollapudi, Feeley, Otsuka, 2007			X*
Gunel, Mutlu, 2007			X
Hagglund, Lauge-Pedersen, Wagner, 2007			X*

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Detailed Chart 3. Classification of observational research studies making use of the GMFCS (N=121) - continued

Authors	Sample Descriptor	Association with GMFCS as Outcome	Association with GMFCS with Outcome
Hayes, Ryan, Stephenson et al, 2007	X		
Henderson, Grossberg, Matuszewski et al, 2007	X		X
Himmelman, Hagberg, Wiklund et al, 2007	X		X
Himmelman, Beckung, Hagberg et al, 2007	X		X
Kerr, McDowell, Cosgrove, 2007	X		X
Kulak, Sobaniec, 2007		X	
Kulak, Sobaniec, Kubas et al, 2007 (1)		X	
Kulak, Sobaniec, Kubas et al, 2007 (2)		X	
Lauer, Stackhouse, Shewokis et al, 2007			X
Maher, Williams, Olds et al, 2007	X		X
Majnemer, Shevell, Rosenbaum et al, 2007	X		
McMulkin, Baird, Gordon et al, 2007			X*
Oeffinger, Gorton, Bagley et al, 2007	X		X
Palisano, Copeland, Galuppi, 2007			X*
Porter, Michael, Kirkwood, 2007	X		
Rogozinski, Davids, Davis et al, 2007			X*
Rosenbaum, Livingston, Palisano et al, 2007	X		X
Sheilds, Loy, Murdoch et al, 2007	X		
Sommer, Urlesberger, Maurer-Fellbaum et al, 2007		X	
Sullivan, Barnes, Linton et al, 2007	X		
Tieman, Palisano, Gracely et al, 2007	X		X
Verschuren, Takken, Ketelaar et al, 2007	X		X*
Voorman, Dallmeijer, Knot et al, 2007			X
Westborn, Hagglund, Nordmark, 2007	X		
Young, Rice, Dixon-Woods et al, 2007	X		

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Authors	Sample Descriptor	Association with GMFCS as Outcome	Association with GMFCS with Outcome
Dahlgren Sandberg, 2006	X		
Damiano, Abel, Romness et al, 2006			X*
Getz, Hutzler, Vermeer, 2006			X
Himmelmann, Beckung, Hagberg et al, 2006	X		X*
Morton, Scott, McClelland et al, 2006	X		X*
Nadeau, Tessier, 2006	X		
Newman, O'Regan, Hensey, 2006	X		
Ohata, Tsuboyama, Ichihashi et al, 2006	X		X
Petersen, Kedia, Davis et al, 2006	X		
Pirpiris, Gates, McCarthy et al, 2006			X
Stevenson, Conaway, Barrington et al, 2006	X		
Stevenson, Conaway, Chumlea et al, 2006	X		
Soo, Howard, Boyd et al, 2006			X*
Tedroff, Knutson, Soderberg, 2006	X		
Vargus-Adams, 2006	X		
Voorman, Dallmeijer, Schuengel et al, 2006			X
Cusick, Vasquez, Knowles et al, 2005	X		
Henderson, Gilbert, Clement et al, 2005	X		
Howard, Soo, Graham et al, 2005	X		
Kilgour, McNair, Stott, 2005	X		
Kulak, Sobaniec, Smigielska-Kuzia et al, 2005		X*	
Jekovec-Vrhovsek, Kocijancic, Prezelj, 2005	X		
Natroshevili, Kakushadze, Gabunia et al, 2005			X
Ones, Yilmaz, Cetinkaya et al, 2005			X
Ostensjo, Carlberg, Vollestad, 2005			X*

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Detailed Chart 3. Classification of observational research studies making use of the GMFCS (N=121) – continued

Authors	Sample Descriptor	Association with GMFCS as Outcome	Association with GMFCS with Outcome
Rose, McGill, 2005	X		
Russell, Gorter, 2005	X		X
Schenker, Coster, Parush, 2005	X		X
Stott, Atherton, Mackey et al, 2005	X		
Vargus-Adams, 2005			X
Vohr, Msall, Wilson et al, 2005		X	
da Costa, Salomao, Berezovsky et al, 2004		X	
Eker, Tuzun, 2004			X
Harries, Kassirer, Amichai et al, 2004	X		
Henderson, Kairalla, Abbas et al, 2004	X		
Houlihan, O'Donnell, Conaway et al, 2004	X		X
Johnston, Moore, Quinn et al, 2004	X		X
Oeffinger, Tylkowski, Rayens et al, 2004			X
Ostensjo, Carlberg, Vollestad, 2004	X		
Senner, Logemann, Zecker et al, 2004			X
Tuzun, Eker, Daskapan, 2004	X		X
Wong, Chung, Hui et al, 2004			X
Fosang, Galea, McCoy et al, 2003	X		
Ostensjo, Carlberg, Vollestad, 2003	X		X

* with GMFCS subgroup analysis

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Detailed Chart 4. Classification of experimental research studies making use of the GMFCS (N=65)

Authors	SD	SP to RA	Type of Intervention					Sample Analysis		
			Medical		AD	Rehab	A/R	General E &/or T	Subgroup	GMFCS as covariate
			Sx	Med						
Blank, von Kries, Hesse et al, 2008	X					X	X			
Bar-Haim, Harries, Belokopytov et al, 2008		X				X				
Chan, Yam, Yiu-Lau et al, 2008			X			X			X	
Christiansen, Lange, 2008		X				X				
Deutsch, Borbely, Filler et al, 2008	X					X				
Eek, Tranberg, Zugner et al, 2008	X							X		
Hoving, Evers, Ament et al, 2008	X			X						
Lee, Sung, Yoo et al, 2008	X							X		
Motta, Stignani, Antonello, 2008	X			X						
Murphy, Milo-Manson, Best et al, 2008	X			X						
Satila, Pietikainen, Iisalo et al, 2008	X			X						
Trost, Schwartz, Krach et al, 2008	X		X			X				
Van Gestel, Molenaers, Huenaerts et al, 2008	X				X					
Wright, Rosenbaum, Goldsmith et al, 2008	X			X						X
Zier, Rivard, Krach et al, 2008	X			X						
Berweck, Schroeder, Lee et al, 2007	X			X						
Bjornson, Hays, Graubert et al, 2007	X			X						
Cherng, Liu, Lau et al, 2007		X						X		
Desloovere, Molenaers, De Cat et al, 2007	X			X						
Dirienzo, Dirienzo, Baceski, 2007							X		X	
Dodd, Foley, 2007	X	X						X		
Fowler, Knutson, Demuth et al, 2007	X							X		
Gannotti, Gorton, Nahorniak et al, 2007			X		X					X

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Detailed Chart 4. Classification of experimental research studies making use of the GMFCS (N=65) - continued

Authors	SD	SP to RA	Type of Intervention					Sample Analysis		
			Medical		AD	Rehab	A/R	General E &/or T	Subgroup	GMFCS as covariate
			Sx	Med						
Hamill, Washington, White, 2007	X						X			
Hoving, van Raak, Spincemaille et al, 2007	X			X						
Johnston, Barr, Lee, 2007	X							X		
Liao, Liu, Liu et al, 2007	X	X						X		
Lowe, Novak, Cusick, 2007	X			X		X				
Macgregor, Campbell, Gladden et al, 2007							X		X	
Meyer-Helm, Borggraefe, Ammann-Reiffer et al, 2007	X				X					
Naslund, Sundelin, Hirschfeld, 2007	X				X					
Odman, Krevers, Oberg, 2007	X						X			X
Phillips, Sullivan, Burtner et al, 2007	X							X		
Saeed, Henderson, Dutton, 2007	X			X						
Senaran, Shah, Presedo et al, 2007				X						
Verschuren, Ketelaar, Gorter et al, 2007	X							X		
Williams, Pountney, 2007	X							X		
Banerjee, Glasson, O'Flaherty, 2006	X			X						
Bar-Haim, Harries, Belokopytov et al, 2006	X	X				X	X		X	
Chen, Wu, Chen et al, 2006	X				X					
Chu, Sala, 2006	X			X						
Footer, 2006	X					X				
Hicdonmez, Steinbok, Beauchamp et al, 2006			X							X
Kim, Steinbok, Wickenheiser, 2006	X		X							
Lowe, Novak, Cusick, 2006	X			X		X				
Mall, Heinen, Siebel et al, 2006	X			X						

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Detailed Chart 4. Classification of experimental research studies making use of the GMFCS (N=65) - continued

Authors	SD	SP to RA	Type of Intervention						Sample Analysis	
			Medical Sx	Med	AD	Rehab	A/R	General E &/or T	Subgroup	GMFCS as covariate
Nemer, Blasco, Russman et al, 2006	X		X	X						
Plotkin, Coughlin, Kreikemeier et al, 2006	X			X						
Satila, Pietikainen, Lehtonen-Raty et al, 2006	X			X						
Scheinberg, Hall, Lam et al, 2006	X			X						
Sullivan, Alder, Bachlet et al, 2006	X						X			
Ahl, Johansson, Granat et al, 2005	X						X			
Satila, Iisalo, Pietikainen et al, 2005	X			X						
van Empelen, Jennekens-Schinkel, Gorter et al, 2005			X							
Woolacott, Shumway-Cook, Hutchinson et al, 2005	X						X			
Wright, Boschen, Jutai, 2005	X						X			
Buckon, Thomas, Jakobson-Huston et al, 2004	X				X				X	
Glanzman, Kim, Swaminathan et al, 2004	X			X	X					
Kondo, Hosokawa, Iwata et al, 2004	X		X						X	
Tieman, Palisano, Gracely et al, 2004	X						X			
Tsoralakis, Evaggelinou, Grouios et al, 2004	X					X				
Bjornson, McLaughlin, Loeser et al, 2003	X			X	X					
Dodd, Taylor, Graham, 2003	X						X			
McBurney, Taylor, Dodd et al, 2003	X						X			
Shumway-Cook, Hutchinson, Kartin et al, 2003	X						X			

Note:

SD = Sample Descriptor
SP = Stratification Prior
RA = Random Allocation
Sx = Surgical Intervention

Med = Medication
AD = Assistive Devices
Rehab = Occupational or Physical Therapy
A/R = Adjunctive or Recreational Therapy
General E &/or T = General Exercises and/or Training

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Detailed Chart 5. Classification of publications regarding the use of the GMFCS in clinical practice according to the “Guide to Physical Therapist Practice” subcategories⁹ (N=13)

Authors	1 ^o or 2 ^o	Examination	Prognosis	Intervention	Outcome
Chan, Yam, Yiu-Lau, et al, 2008	2 ^o	X			
Hanna, Bartlett, Rivard et al, 2008	1 ^o				X
Ketelaar, Russell, Gorter, 2008	1 ^o	X	X	X	X
Thompson, Beath, Bell et al, 2008	2 ^o	X			X
Beckung, Carlsson, Carlsdotter et al, 2007	2 ^o	X	X	X	X
Carnahan, Arner, Hagglund, 2007	2 ^o	X	X	X	X
Gollapudi, Feeley, Otsuka, 2007	2 ^o		X	X	
Hagglund, Lauge-Pedersen, Wagner, 2007	2 ^o	X		X	
Palisano, Copeland, Galuppi, 2007	2 ^o	X		X	
Soo, Howard, Boyd et al, 2006	2 ^o	X	X		
Hicdonmez, Steinbok, Beauchamp et al, 2005	2 ^o	X	X		
Kondo, Hosokawa, Iwata et al, 2004	2 ^o	X		X	
Johnston, Moore, Quinn et al, 2004	2 ^o	X		X	