

Diving Below the Surface of Progressive Disability: Considering Compensatory Strategies as Evidence of Sub-Clinical Disability

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Objectives. To provide a comprehensive review regarding the role of activity and participation compensations within the disablement process, identify directions for future research, and discuss the implications of compensation pertaining to public health initiatives aimed at preventing and reversing disability.

Method. This article evaluated how using compensatory strategies to cope with functional deficits reveals important transitions within the disablement process and signifies a unique opportunity to identify early declines in function.

Results. Previous research suggests that (a) adopting compensatory strategies to maintain activity/participation is strongly associated with functional decline and disease severity and significantly predicts the onset of limitations/restrictions; (b) compensation can be reliably quantified; and (c) contextual knowledge about how individuals adapt to functional decline can be used to describe transitions in the disablement process.

Discussion. Characterizing subtle adaptations prior to the onset of activity limitations and participation restrictions will not only aid in understanding the complex disablement process but also help inform social services and future prevention strategies. Overall, this article integrates the concept of compensation into the current model of disability and proposes a framework for identifying and interpreting compensatory behavior.

Key Words: Preclinical disability—Compensation—ICF—Subclinical disability.

MANY older adults use compensatory strategies to navigate their environment and maintain their roles in society. Compensation is an adaptation that individuals use to cope with detrimental changes in body structure or function, the environment, and personal factors in an effort to maintain activity and participation levels. These strategies may be obvious, like using a cane, or more subtle, like choosing to use a handrail while climbing a flight of stairs. Regardless of the strategy taken, the act of compensating allows older adults to maximize gains and minimize losses in functioning (Baltes, 1987). Although compensation has traditionally been described as a “positive” process, from a different lens, the use of compensatory strategies may be a warning sign that signals imminent decline within the disablement process.

Fried and colleagues (1991) were the first to operationalize the act of compensating into a construct to identify behaviors indicating early and subtle losses in function that act as precursors of having difficulty with tasks of daily life. They observed that older adults who report modifying the frequency or changing the manner in which daily tasks are performed, yet report no difficulty, are at significantly elevated risk of reporting outright difficulty in the future (Fried, Bandeen-Roche, Chaves, & Johnson, 2000). The concept of “pre- or subclinical disability” originated from this research

and has been used to help describe an important intermediate phase that occurs with progressive loss of function and prior to the onset of disability. Despite the fact that this stage of functional loss is clearly important for identifying individuals at an early stage, the concept was never fully incorporated into traditional models of disablement. Today, as it is clear that health conditions do not simply arise from clinical origins, the terminology of “pre- or subclinical disability” needs to be recast to reflect that changes in function are the result of complex interactions between biological, psychological, and social factors. As such, indices of activity and participation compensations are currently underutilized and might be overlooked by practitioners using the World Health Organization’s (WHO) contemporary model of disability, the International Classification of Functioning, Disability, and Health (ICF; WHO, 2001). Although “pre- or subclinical disability” language does not align well with the more comprehensive ICF scheme, the core concept of compensation remains a valuable component to consider in the ICF.

This article is framed in sections that are linked to the original concept of “pre- or subclinical disability, where Fried et al. (1991) likened progressive disability to an iceberg. The notion at that time was that traditional models of disability and their associated measures only captured

the tip of the iceberg, as they only detect functional deficits once they have become clearly visible (e.g., “unable” to perform a task or participate in a specific social role). Recognizing compensatory strategies that occur “below the surface” offers an opportunity to identify early indicators of activity limitations and participation restrictions. Additionally, compensation offers a conceptual process for how individuals might transition “in and out” of their activity limitations and participation restrictions. As such, this paper will outline how compensation can be viewed within the ICF by reviewing evidence of the relationship between using compensatory strategies and the onset of activity limitations and participation restrictions. The article will also highlight a framework for measuring compensatory strategies as important markers of transition between categories in the current ICF model.

WHAT LIES ABOVE THE SURFACE—MODELS OF THE DISABLEMENT PROCESS

Because the concept of preclinical disability is rooted in earlier models of disablement, we will briefly describe how the definition of disability and idea of using compensatory strategies as an indicator of functional transitions have evolved before explaining how the notion of compensation complements the ICF. The ICF’s conceptualization of the disablement process originates from medical models and basic social models of disability, such as the WHO International Classification of Impairment, Disability, and Handicap (WHO, 1980) and Verbrugge and Jette (1994) models, which were also used to develop the concept of preclinical disability (Fried, Herdman, Kuhn, Rubin, & Turano, 1991; Fried, Young, Rubin & Bandeen-Roche, 2001). In response to criticism of previous models of disability, the ICF presents an integrated biopsychosocial perspective of changes in health and uses more inclusive language than previous models that addresses all of human functioning and not solely disability. Despite confusing inconsistencies in terminology, these models similarly depict the main progressive disablement pathway. Therefore, researchers have been able to use the same tools for assessing stages in the disablement process regardless of which model they adopt. Such conceptual similarities among models also indicate that the tenets of preclinical disability are equally as applicable to the ICF as they were in traditional models. For clarity, the present review will utilize the terminology presented in the ICF, as it represents the most current and accepted language used to describe disability.

The ICIDH model, the Verbrugge and Jette framework, and the ICF are all composed of a tripartite definition of disablement. All three models portray changes in function within three domains: at the organ level, the person as a whole, and the person as a whole within an environmental context. Where Verbrugge and Jette’s scheme conceptualizes impairment, functional limitation, and disability,

the ICIDH model describes disablement using the terms impairment, disability, and handicap (WHO, 1980). The ICF presents similar constructs using the terms body structure and function, activity, and participation. Decrements at each level within the ICF are described as impairments, activity limitations, and participation restrictions, respectively. The classification of impairment as any loss or abnormality of a physiological, anatomical, or psychological structure or function (e.g., muscle atrophy) is identical in all three models. Verbrugge and Jette’s model indicates that impairments induce functional limitations, whereas the ICIDH model progresses from impairment to disability. The ICF dictates that declines in body structure or function can cause activity limitations. Critically, the ICIDH characterizes disability as any restriction or lack of ability to perform an activity within the range considered normal for a human being (e.g., difficulty in musculoskeletal performance), which parallels Verbrugge and Jette’s description of functional limitation as well as the ICF’s definition of activity limitations. Therefore, all three models indicate the second major stage in the disablement process involves functional activity decrements occurring at a whole-person level outside of a social or environmental context.

Practitioners have developed numerous tools to identify functional changes at the person level in a variety of settings based on this conceptualization of the second phase in the disablement process (Harris, Kovar, Suzman, Kleinman, & Feldman, 1989; Katz, Ford, Moskowitz, Jackson, & Jaffe, 1963; Katz, 1983; Lawton & Brody, 1969). Traditionally, functional deficits at the whole-person level have been assessed by self-reported or interviewer-observed difficulty (a little, some, or a lot) and objective measures of performance (Brach, VanSwearingen, Newman, & Kriska, 2002; Huang, Perera, VanSwearingen, & Studenski, 2010; Sayers, Jette, Haley, Heeren, Guralnik, & Fielding, 2004). For example, a multitude of performance-based measures quantify functional task performance, including the weight a person lifts or a distance attained (i.e., walking test). The Short Physical Performance Battery (SPPB) represents one of the most commonly implemented assessments of functioning at the whole-person level. Notably, concern has arisen regarding the ability to differentiate between the ICF’s activity and participation dimensions. Though recent findings suggest that revising the ICF by blending activity and participation domains may create a more functional model (Jette, Tao, & Haley, 2007), empirical evidence indicates that these constructs can be distinguished within the current ICF framework (Jette, Haley, & Kooyoomjian, 2003). Specifically, activity limitations, as defined in the ICF, can be assessed by querying performance of mobility activities (e.g., walking a mile, climbing stairs, getting up from the floor) and daily activities (e.g., making a bed, opening a heavy door, washing dishes). Jette and colleagues’ findings confirm that traditional approaches for detecting functional deficits at the whole-person level that measure changes in

discrete functional task performance remain appropriate for indexing activity limitations. As all three models agree that a reduced ability to perform functional activities “outside of a social context” precedes participation restriction (i.e., the inability to perform life behaviors required to fulfill one’s normal social role, also known as outright disability), the activity limitation phase represents the most commonly assessed and readily measurable component of disablement in a laboratory setting.

According to Verbrugge and Jette and the ICIDH, individuals progress to the subsequent phase in the disablement process when difficulty performing functional activities reaches a threshold that prevents them from fulfilling normal daily roles. Though they use different terms (handicap vs disability) for the end stage of the disablement process, both models assert that the final phase is marked by a loss or reduction in the capacity to fulfill certain social roles and tasks that are linked to functional deficits at the whole-person level. Therefore, to be categorized as disabled, activity limitations must culminate to a point that reduces roles required for independent living. Although similar to previous models, the final stage of disablement in the ICF, participation restriction, is defined more broadly as problems with involvement in life situations. Participation requires the performance of complex sets of life behaviors that involve a variety of activities or functional tasks.

Based on all of the aforementioned conceptualizations, participation restriction, or outright disability in traditional terms, is signified by having “difficulty” participating in social activities that occur in both private and public settings

(e.g., taking care of one’s own health and taking part in social activities). Because difficulty performing life behaviors “in one’s normal environment” represents a fundamental feature of participation, participation capacity is most commonly measured using questionnaires like the Late Life Function and Disability Instrument (LLFDI; Jette, Haley, Coster, Kooyoomijian, Levenson, Heeren, et al., 2002), which record self- or proxy reports of degree of difficulty (some, a little, a lot, cannot do) or limitation (a little, somewhat, a lot, completely) experienced when performing instrumental ADLs (IADLs), such as household management or running errands, and social life behaviors, including going out with others to public places and participating in organized social events. As such, participation restriction refers to a reduced fulfillment of social roles and is indexed using functional changes at a whole-person level within an environmental context.

Fried and colleagues (1991) criticized traditional models of disability (i.e., ICIDH), suggesting that an intermediary stage must exist, in which people cope with gradually increasing functional deficits before crossing the threshold of disability. This critical transitional phase is conceptualized as an intermediary stage that spans from impairment to outright disability, thus opting not to distinguish functional limitation and a “preclinical phase” of disability as unique (Fried, Bandeen-Roche, Williamson, Prasada-Rao, Chee, Tepper, & Rubin, 1996). Figure 1A illustrates where Fried and colleagues’ preclinical disability phase occurs within the ICIDH and Verbrugge and Jette models of disability. The key feature of the preclinical disability concept was that individuals using compensatory strategies to cope

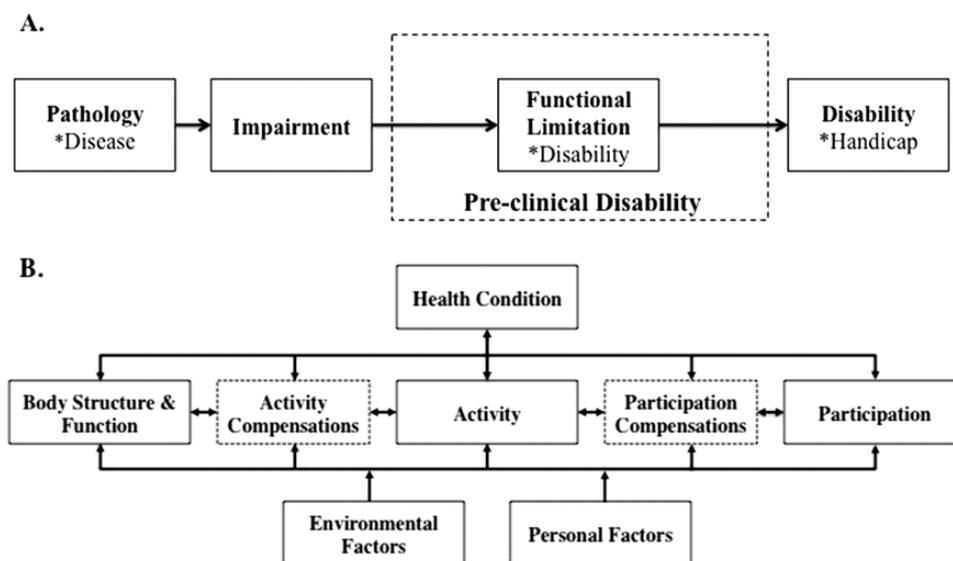


Figure 1. (A) Fried et al. (1991, 1996) originally conceptualized preclinical disability as a transitional stage between impairment and disability, which parallels functional limitation (as illustrated earlier within Verbrugge and Jette’s disablement pathway). Accordingly, descriptive information about compensatory behavior during functional tasks, activities of daily living, and instrumental activities of daily living can be implemented to identify transitional phases during disablement. * denotes corresponding International Classification of Impairment, Disability, and Handicap terminology to demonstrate where preclinical disability occurs within the International Classification of Impairment, Disability, and Handicap model. (B) Expanding the International Classification of Functioning, Disability, and Health to incorporate transitional phases (denoted by the dashed lines) will more accurately account for how individuals adapt to functional decline prior to experiencing outright activity limitations or participation restrictions.

with functional impairments occupy an intermediary stage of functional decline. To assess this hypothesis, Fried and colleagues produced a series of papers that evaluated compensatory strategies on a combination of functional tasks, activities of daily living (ADLs), and instrumental activities of daily living (IADLs) (e.g., modifying the way individuals lift and carry 10 pounds, perform a chair stand, or do heavy housework; Fried et al., 1996, 2000, 2001).

The notion of “preclinical disability” has yet to be conveyed in the currently accepted disability framework (i.e., the ICF). The ICF’s depiction of the disablement process represents a significant departure from the earlier models used to initially conceptualize preclinical disability, in that it recognizes the multifactorial, multilevel, and multidirectional interactions that occur in the disablement process (Whiteneck, 2006). However, the concept of using compensatory strategies to cope with demands corresponds equally well to the current ICF (see Figure 1B for a schematic of the ICF model including activity compensation and participation compensation phases). For example, as the model currently stands, individuals who must modify the way they execute activities to enable the continued performance of specific tasks, but still perform those activities, would not be identified as high risk for disability. Although the concept of modifying personal and environmental factors (activity and participation compensations) is not specifically addressed in the ICF, the addition could better capture transitional phases in the disablement process.

A growing number of researchers recognize that the disablement process contains subtle adaptations and critical transitional phases that are still not adequately captured by current models or commonly used assessment tools. Aforementioned measures, such as the objectively measured SPPB and self-assessed LLFDI, represent strong indices of activity performance and participation capacity, respectively. However, the development of disability is often times a gradual process that is not recorded comprehensively with these assessment instruments that index surface-level changes. Furthermore, the literature has documented extensive evidence of compensatory strategy use that characterizes a unique progression into outright disability (Fried et al., 2001; Wolinsky, Miller, Andresen, Malmstrom, Miller, & Miller, 2007), yet such transitional adaptations often go undocumented by practitioners and researchers. Such subtle adaptations, particularly during critical transitional time points, might serve to identify people at early stages to prevent the onset of activity limitations and participation restrictions.

CHARTING THE TIDES OF CHANGE—ESTABLISHING PATTERNS OF ADAPTATION TO MAINTAIN ACTIVITY AND PARTICIPATION

Ideal strategies to prevent the onset of activity limitations and participation restrictions would include identifying characteristic changes indicative of functional deficits

and establishing whether these attributes facilitate efforts to distinguish high risk individuals. The previous section outlined assessments that are frequently used to distinguish different levels of functioning (i.e., self-reported function and timed performance). However, the adaptations underlying the progression of disability warrant discussion as well. Before considering how to improve methods of assessing functional status and ways to reduce signs of disability, particularly by indexing transitional phases, a guiding conceptual framework outlining subtle adaptations occurring during functional decline should be established. Such a framework could be used in tandem with the ICF to identify high risk individuals early and inform intervention strategies. This framework also provides a theoretical rationale for the existence of measurable transitional phases lying “below the waterline.”

The work of Baltes and colleagues (1980, 1987, 1990, 1997; Ebner, Freund, & Baltes, 2006) provides remarkable insight regarding how people typically adapt in response to declining physical and cognitive function as they age. Historically, gerontologists have defined aging as a process of decline (Kirkwood, 1985), but Baltes’ framework depicts aging as a dynamic developmental process involving both losses and gains in function (Baltes, 1987). In their theory, known as selective optimization with compensation (SOC), successful aging is characterized by systematic, adaptive changes that maximizes gains and minimizes losses in functioning (Baltes & Baltes, 1980, 1990, 1997; Marsiske, Lang, Baltes, & Baltes, 1995). *Selection* refers to the process of selecting domains or goals of functioning due to peoples’ inherent limitations in resources such as time and energy. Selection may change in numerous ways. One alteration, termed loss-based selection, transpires when previously available resources diminish, thereby requiring reconstruction of goal hierarchies. *Optimization* pertains to the allocation and refinement of resources to achieve the highest level of performance possible in selected domains. Lastly, *compensation* occurs when substitutive processes are necessary to maintain a certain level of functioning in a selected domain as resources are lost. Although these sub-processes are present throughout the entire life span, the role of their dynamics is amplified in older adults as they adapt to age-induced biological losses (See Figure 2A; Baltes, 1987, 1997; Marsiske et al., 1995).

Originally presented as a social model, the SOC framework nicely complements models of disability, particularly the ICF. Original hypotheses of Fried et al. (1991) about the progression of disability and preclinical levels of functioning (described later), as well as subsequently collected evidence in support of those predictions closely align with Baltes and colleagues’ theory of successful aging (Fried et al., 1996, 2000; Manini, Cook, VanArnam, Marko, & Ploutz-Snyder, 2006; Miller, Wolinsky, Malmstrom, Andresen, & Miller, 2005; Miller, Andresen, Malmstrom, Miller, & Wolinsky, 2006; Rush, Watts, & Stanbury, 2011;

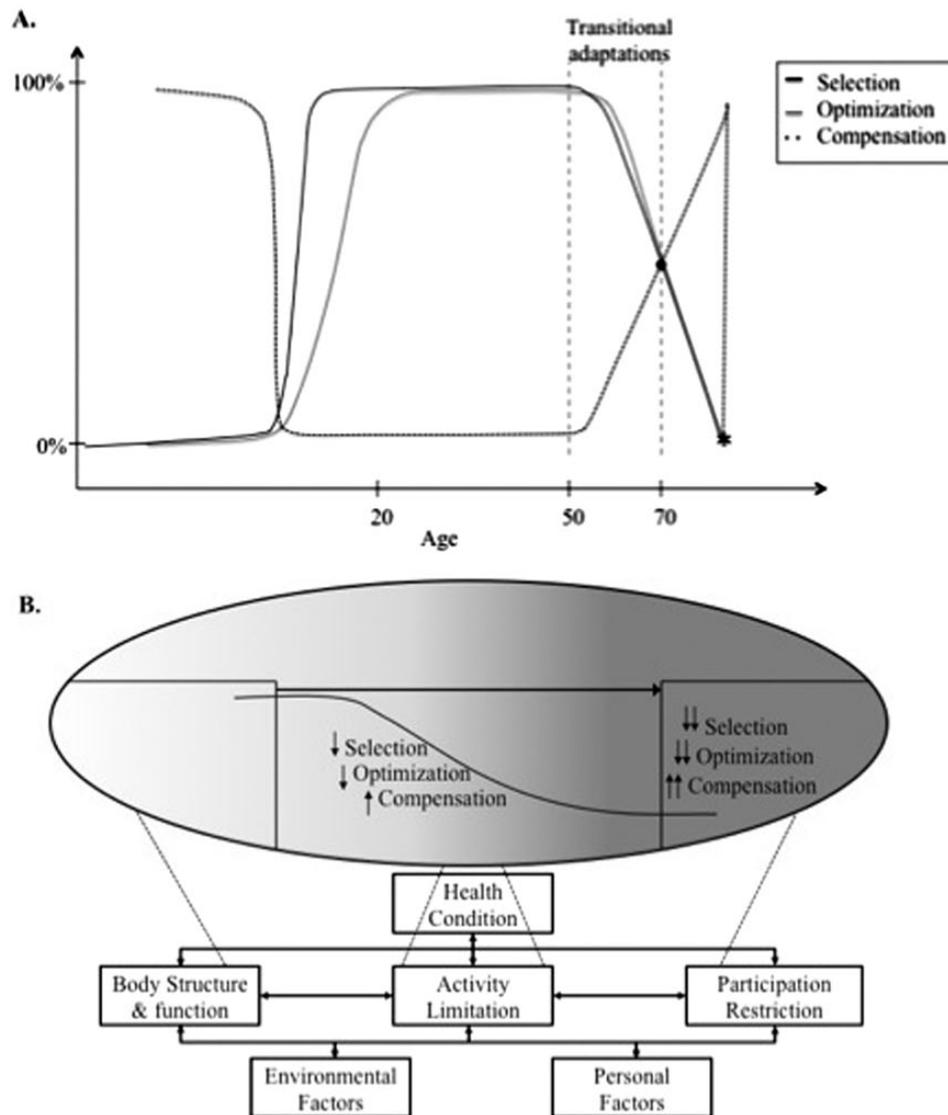


Figure 2. (A) The conceptual figure demonstrates how the selective optimization with compensation (SOC) subprocesses change across the life span. Transitional phases are characterized by significant declines in selection and optimization and increases in compensation. The point at which the subprocesses intersect is the theoretical onset of limitation/restriction. * denotes when a person becomes dependent and selection, optimization, and compensation cease to occur. (B) A schematic diagram illustrating how Baltes' (1987) SOC framework informs predictions about disability. This model provides a theoretical rationale regarding changes in function during the progression of disability, which is depicted here using the International Classification of Functioning, Disability, and Health (WHO, 2001). This conceptual model illustrates one potential pathway through which an individual might adapt to underlying functional changes by altering selective optimization with compensation subprocesses to maintain activity and compensation.

West, Munoz, Rubin, Bandeen-Roche, Broman, & Turano, 2005; Wolinsky et al., 2005, 2007). Namely, Fried and colleagues' suggestion that individuals will adapt to underlying functional deficits by modifying the frequency or method with which they perform certain tasks mirrors the SOC prediction that people make subtle adaptations to minimize losses and maximize gains.

The SOC framework also provides a theoretical rationale for changes in physical and cognitive performance. First, evidence that individuals report modifying the frequency with which they perform certain activities and participate in life behaviors as they transition along the spectrum of

disability corroborates Baltes and colleagues' (1998) theory that as resources deplete, individuals' "selection" of activities changes. For example, older adults may opt to perform certain activities (e.g., walking a quarter mile) and participate in life behaviors (e.g., running errands) less often. Second, data that showed that functional task performance is associated with decrements in functioning indicates that declines in "optimization", as operationalized with slow walking speed, are a feature of the disablement process (Bandeen-Roche et al., 2006; Cress, Buchner, Questad, Esselman, deLateur, & Schwartz, 1999; Manini et al., 2006; Ostir, Volpato, Fried, Chaves, & Guralnik, 2002).

Thirdly, modifying the method of performing functional activities and participating in life behaviors is the hallmark of the preclinical disability concept, which coincides directly with the “compensation” portion of the SOC framework. As [Fried et al. \(1991\)](#) and [Baltes P. B & Baltes M. M. \(1980\)](#) and [Baltes \(1997\)](#) hypothesized, when resources are reduced (i.e., due to changes in the environment, personal factors, or functioning at the organ or whole-person level), people develop alternative strategies that enable them to continue performing activities and participating in life behaviors. These strategies can also be operationalized for research purposes. For example, work using the Modification (MOD) scale ([Manini et al., 2006, 2007](#); [Marko, Neville, Prince & Ploutz-Snyder, 2012](#)) demonstrates that compensatory strategies can be reliably quantified during the performance of mobility and daily activities in a standard environmental setting. These findings suggest that researchers could use tools to quantify compensatory behavior for the purpose of understanding transitions within the ICF.

In sum, the SOC framework provides a strong theoretical basis for recently developed measurements of physical function and the conceptualization of using compensatory strategies as indicators of functional decline. Applying the SOC framework to the ICF would (a) provide a more detailed perspective of the dynamics underlying the progression of disability (see [Figure 2B](#)); (b) supply a guiding framework for predictions regarding how changes in body structure and function, activity, participation, and biopsychosocial factors interact throughout the disablement process; and 3) identify individuals who are experiencing early transitions toward activity limitations and participation restrictions.

DIVING BELOW THE SURFACE OF THE DISABLEMENT PROCESS

Fried and colleagues brought forth the concept of preclinical disability to identify early transitions in the disablement process that are well suited for prevention efforts ([Fried et al., 1991](#)). They contended that disability prevention efforts would continue to be ineffective as long as practitioners and researchers possessed a superficial understanding of the disability process. Under the traditional system for evaluating progressive disability, individuals typically receive treatment following a medical evaluation for a condition that leads to functional deficits that have surpassed a tolerable threshold. Thus, individuals at earlier stages of functional decline, and who were at risk for developing activity limitations and participation restrictions, oftentimes “fall through the cracks,” marking a missed opportunity to prevent further deterioration. Fried and colleagues proposed that intervening during a phase in which individuals are still independent but demonstrate subtle functional impairments might hold more promise for prevention efforts as opposed to treating and rehabilitating people who

already have difficulty. Accordingly, they asserted that diving below the surface to investigate more concealed reductions in function, such as phases in which compensatory strategies are used to maintain activity and participation, is required to advance our understanding of the disablement process and how to treat it.

DISCOVERING THE ICEBERG BELOW THE WATERLINE—CONCEPTUALIZATION AND IDENTIFICATION OF PRECLINICAL DISABILITY

Fried and colleagues initiated efforts to elucidate previously undetected changes occurring prior to outright disability in their 1991 paper by presenting four hypotheses to guide investigations of what lies below the waterline. The first hypothesis built upon [Lilienfeld and Lilienfeld’s \(1980\)](#) notion that the stages of disability should be further subdivided to include transitional phases. Fried et al. hypothesized that individuals experience a measurable transitional phase after the onset of functional impairments and prior to the onset of disability. This transition would entail a unique interchange of how individuals with impairments adapt to their environment. The hallmark of this stage would identify functional losses that precede outright difficulty. Fried et al. suggested that individuals who begin adapting to their environment due to underlying impairments, but do not consider these efforts as having difficulty, represent a population at risk of developing outright difficulty.

In their remaining hypotheses, [Fried and colleagues’ \(1991\)](#) outlined potential characteristics of this transitional phase. Their second hypothesis proposed that this transitional phase could present in two forms; individuals with subtle functional impairments will either decrease their activity level without altering task performance or they will modify the way they perform a task due to limitations imposed on the normal method of execution. These subtle modifications do not result in people reporting difficulty with a task because they have developed coping strategies to keep them manageable. The third hypothesis stated that the use of compensatory strategies progresses predictably, with strategies being adopted for physically challenging tasks before less demanding tasks. Finally, they posited that individuals use compensatory strategies to limit the impact of impairments on functioning.

The next step was to establish the validity of this concept by assessing patterns in epidemiological research. [Fried et al. \(1991\)](#) presented preliminary evidence to support the existence of this transitional phase in a pilot study of 42 older adults. They adhered to the traditional method of ascertaining functional impairments by administering a survey that assessed 23 ADLs and IADLs. However, they also probed whether participants had altered the time taken to perform the tasks or modified the frequency or method with which they performed them. As postulated, of the individuals who reported no difficulty performing the tasks, 20%

reported modifying the method they completed the tasks. Case reports from this sample also confirmed that “individuals reporting no difficulty frequently employed compensatory strategies to alleviate the influence of impairments.”

The next goal was to establish that the use of compensatory strategies signified an intermediate stage of functioning that occurred prior to having outright difficulty with a task. In 1996, Fried et al. demonstrated that individuals who reported no difficulty performing ADLs and IADLs were asked whether they had: a) modified the method used to perform any of the tasks or b) changed the frequency with which they performed the tasks. Participants also completed objective performance measures that included a 15-foot walk, chair rise, stair ascent and descent, grip strength, and pinch strength. In other studies, physical performance and disease frequency were compared across three groups: high functioning (no difficulty, no modifications), preclinically disabled (no difficulty but modified method or frequency of task performance), and disabled (having difficulty with a specific task). Physical performance was worst in the group reporting difficulty and best in the group without difficulty, whereas preclinically disabled older adults displayed intermediate physical function. Additionally, disease severity and functional impairment progressed in a stepwise fashion across the three categories of high functioning, preclinically disabled, and disabled. The discovery that preclinically disabled individuals are at elevated risk for developing mobility disability, functional limitations, and diseases like osteoarthritis, provided compelling support for the existence of this unique stage in the disablement pathway (Fried et al., 2001).

The key evidence that solidifies preclinical disability as a critical phase in the disablement pathway was demonstrated in several prospective studies (see Figure 3; Fried et al., 2000; Hazuda, Gerety, Lee, Mulrow, & Lichtenstein, 2002; Miller et al., 2005, 2006; Wolinsky et al., 2005, 2007; Mänty et al., 2007; Weiss, Wolff, Egleston, Seplaki, & Fried, 2012). The general conclusion from these studies was that participants who reported no difficulty but stated they had modified the method or frequency with which they performed daily tasks (e.g., walking half a mile) were at a three to fourfold higher risk of reporting outright difficulty in future follow-up assessments. Additional research also showed that women who compensate, yet report no difficulty, are 3.77 times more likely to report falls at a 1-year follow-up compared with their counterparts who report no difficulty and no compensation. More mechanistic research demonstrated that people who report using compensatory strategies also modify walking behaviors by taking more steps and decreasing the frequency of daily ambulatory activities (Petrella & Cress, 2004). Such findings confirm hypotheses of Fried et al. (1991) hypotheses about importance of preclinical disability as a transitional stage in the disablement process, as well as the development of performance modifications that occur prior to the onset of disability.

Findings from the African American Health (AAH) study have also been highly supportive of the notion that using compensatory strategies are a precursor to activity limitations and participation restrictions (Miller et al., 2005, 2006; Wolinsky et al., 2005, 2007). As in the previous studies, participants were asked if they had difficulty performing ADLs/IADLs or functional tasks. If “no difficulty” was reported then follow-up questions were asked about modifying the frequency or method of task performance. Follow-up questions were modified to include the phrase “since the age of 40,” which sought to clarify the questions by providing a frame of reference for participants. Based on AAH data, Miller et al. (2005) reported that the prevalence of preclinical disability in adults 50+ years old was significantly higher for inner-city dwellers (14%–40%) compared with suburban dwellers (10%–39%). The AAH study also confirmed the prognostic value of assessing preclinical disability. Preclinically disabled individuals were more likely to develop disability 1–2 years later (Wolinsky et al., 2005). Preclinically disabled African Americans were at 1.68 and 4.46 times greater risk for experiencing outright difficulty walking half a mile and climbing stairs, respectively, compared with those without preclinical disability. Similarly, individuals with preclinical disability were at 2.5 times greater risk for reporting difficulty stooping/crouching/kneeling and lifting and carrying an object as heavy as 10 pounds at follow-up than older adults without preclinical disability. As originally tested in the Women’s Health & Aging Study, evidence from the AAH confirm that the use of compensatory strategies to maintain activity and participation represent a key marker in the transition toward reporting difficulty with a task or life behavior.

NEW APPROACHES TO MEASURING BELOW THE WATERLINE—INDICES OF COMPENSATION

The previous review highlights the importance of delving beyond shallow measures of limitations or difficulty with specific daily tasks. New approaches are needed to detect more submerged signs of functional decline, particularly compensatory adaptations used to maintain activity and participation. Such assessments will help to identify at-risk individuals at an early stage of disability and develop optimally effective interventions to delay disablement. Unfortunately, current methods to identify individuals with slowly diminishing functional capacity are not well established (Lunney, Lynn, Foley, Lipson, & Guralnik, 2003). The concept of using compensatory strategies as indicators of underlying functional decline opens a new avenue for establishing an early warning system to target older adults in the ICF construct.

Due to the limited perspective offered by previous models of disability, prior research on the role of compensatory strategies within the disablement process have only tapped the surface of concept’s potential. The widespread

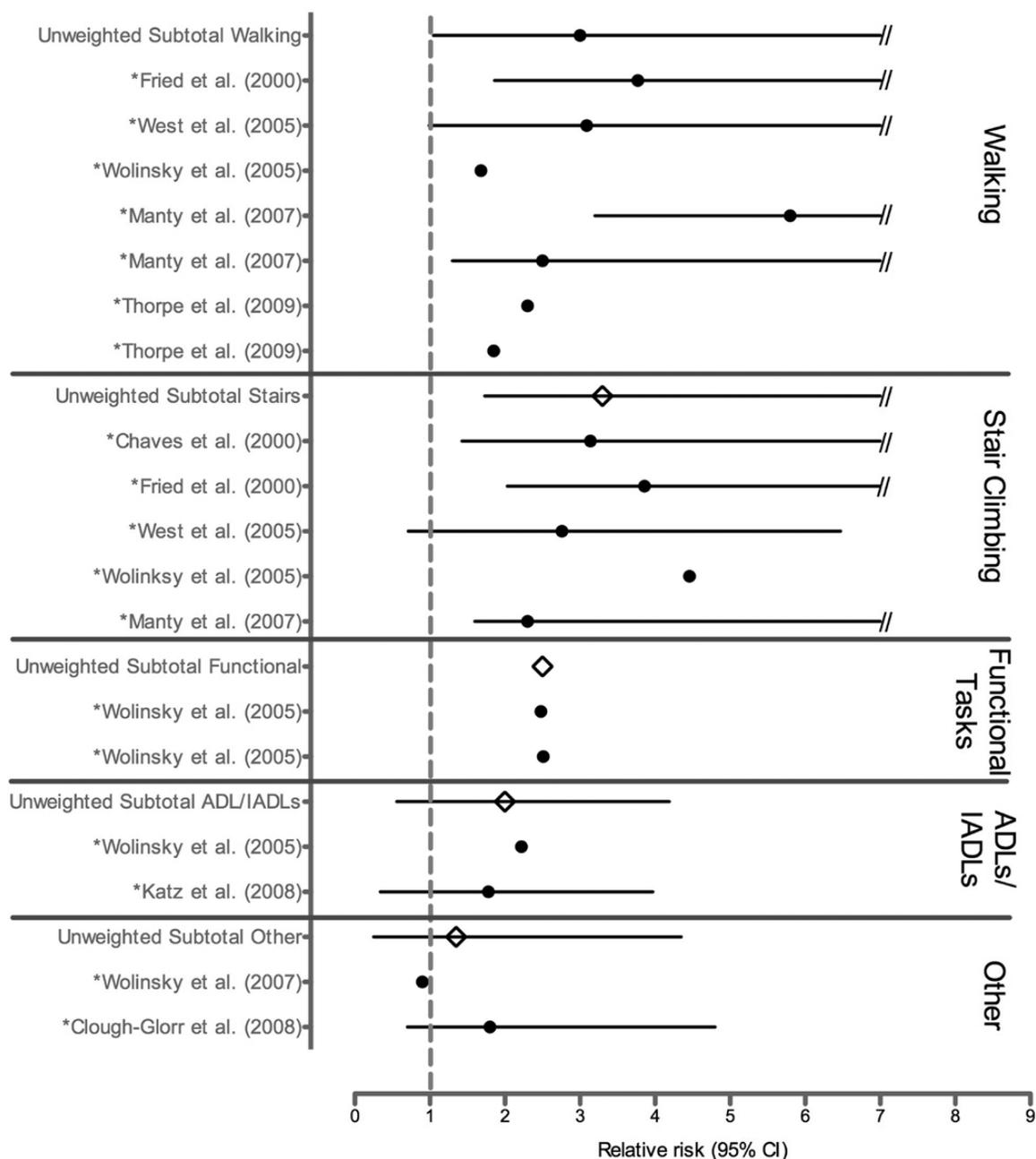


Figure 3. Relative risk of future disability for adults reporting no difficulty but use of compensatory strategies compared with individuals reporting no difficulty and no modification on functional tasks and activities of daily living (ADLs)/instrumental activities of daily living (IADLs). // denotes truncated upper limit >7.

adoption of the ICF necessitates that the vocabulary used to describe “preclinical disability” be recast and facilitates the expansion of the “compensatory strategy” concept. The ICF framework encourages researchers and clinicians to view disability less as a clinical diagnosis and more of a social construction. The ICF illustrates that the development of activity limitations and participation restrictions depends upon not only physiological changes but also the environment (e.g., assistive devices and technology) and personal factors (e.g., social support, coping styles, and accessibility). As such, recasting the term preclinical disability to

“activity compensations” and “participation compensations” represents a more appropriate and consistent language for describing important transitional adaptations occurring before the onset of limitations and restrictions that are not solely reliant on medical origins.

Based on the multifactorial account of changes in function provided by the ICF, the concept of compensation should be broadened to reflect biopsychosocial influences on adaptive behavior. Previous iterations of the concept do not account for the potential influence of environmental, social, and personal factors that may affect compensatory behavior. The

assessment of compensatory strategies has been limited to modifications in the frequency or method with which mobility and daily activities are performed. Considering a wider range of compensatory adaptations used to maintain activity and participation will more accurately depict the pathways through which individuals transition into disability, as well as align more closely with the ICF. For example, compensatory strategies may involve modifying the environment (e.g., installing assistive devices or moving to a smaller home) or depend upon personal factors (e.g., having a family member to provide assistance or a resilient coping style). It is hoped that establishing a more comprehensive perspective on transitions within the ICF will build a better understanding of the disablement process and facilitate prevention efforts.

As compensatory adaptations can manifest in a vast variety of strategies, researchers and clinicians require a framework for systematically measuring and interpreting compensations. We assert that compensatory strategies can be delineated into “intrinsic” and “extrinsic” compensation categories. Specifically, intrinsic compensations require adapting internal factors (e.g., movement strategies) within a given environment to maintain activity and participation despite underlying functional deficits. Examples of intrinsic compensatory strategies include rocking forward to rise from a chair, walking at a slower pace to grocery shop, and leaning on a handrail to descend stairs. Extrinsic compensations consist of adaptations that involve manipulating external factors, such as modifying the environment (e.g., installing assistive devices or transferring performance of activities/participation to virtual environments) or enlisting social support (e.g., requiring the assistance of a caregiver), to cope with health conditions for the purpose of maintaining activity and participation. Relying on a cane to walk around the house, moving to a smaller apartment to reduce housework, and receiving car rides from friends to complete errands represent examples of extrinsic compensatory strategies.

Devising a hierarchy of compensatory strategies demonstrating the typical order through which individuals need to utilize compensations will help contextualize how these different forms of adaptation occur during the disablement process. Such a hierarchy will guide interpretations regarding the degree of functional decrement based on the compensatory strategies required. The proposed hierarchy suggests that in the early stages of a functional deficit, individuals initially need to perform subtle intrinsic compensations before progressing to more extensive intrinsic compensations. As the health condition worsens, individuals typically transition from using intrinsic to using extrinsic compensatory strategies. Requiring the assistance of another person denotes the most extensive type of extrinsic compensatory strategy. Assistance from others marks the final step in compensation in that if assistance from others is unavailable the individual’s activity instantly becomes limited or

their participation is restricted. To provide an example, an individual with osteoarthritis who wants to maintain the ability to climb stairs at home might initially slow his/her stair climbing speed (a subtle intrinsic compensation) before eventually requiring the use of the handrail (a more extensive intrinsic compensation). As the osteoarthritis progresses, the individual may install assistive devices, like a stair lift (more subtle extrinsic compensation), until finally the assistance of a caretaker is needed (extensive extrinsic compensation) to ascend the stairs.

Notably, there is clear evidence that compensatory strategies can be hierarchically ranked into severity categories when tasks are performed in a standardized environment and with standard instructions asking an individual to perform an activity to the best of their abilities without compensating, if possible (e.g., attempt to stand up from the chair without using the armrests). Although a multitude of factors (e.g., physical, social, and psychological) may underlie why a person chooses to use a particular compensatory strategy (Gignac, Cott, & Badley, 2002), these standardized conditions are implemented to reveal the “need” to use a compensatory strategy to complete the task. Importantly, they reveal a stepwise severity of compensation and are highly correlated with measures of physical function and overall health (Fried et al., 2001; Manini et al., 2006; Wolinsky et al., 2007). We supply an initial framework here, but robust instruments to rank the severity of compensatory strategies in a person’s environment remain largely underdeveloped.

As knowledge of the role and dynamics of compensatory strategies within the disablement process expands, the need for comprehensive, objective, standardized indices of function becomes increasingly apparent. Self-report method of measuring compensation of Fried et al. (1996) has been implemented with success in numerous populations (Miller et al., 2005; Petrella & Cress, 2004; West et al., 2005; Wolinsky et al., 2007), has strong internal validity, and excellent test-retest reliability (Fried et al., 1996; Rathouz, Kasper, Zeger, Ferrucci, Bandeen-Roche, Miglioretti, & Fried, 1998; Miller et al., 2005). Additionally, these concepts developed by Fried and colleagues can be included in more contemporary instruments in Gerontological research (e.g. LLFDI; Jette et al., 2002). However, although self-report indices are appropriate for labeling individuals with specific characteristic, they are vulnerable to discrepancies in memory and candor and are typically less sensitive to change than performance indices. One could also argue that this measure reveals a disposition and not necessarily a factor that can be altered. Objective measures of compensation would complement data from self-reports and add a unique dimension to understanding whether activity or participation modification is reversible (Curb et al. 2006). Objective tools would also enable researchers to develop a more comprehensive perspective of older adults’ level of functioning as they approach limitation and restriction.

Geriatricians and Gerontologists have enhanced the prognostic evaluation of functional impairments by developing more direct, objective measures of physical performance (Elam, Graney, Beaver, El Derwi, Applegate, & Miller, 1991; Rantanen, Guralnik, Foley, Masaki, Leveille, Curb, & White, 1999). These performance tests are completed in a standardized environment that does not permit intrinsic or extrinsic compensations. Therefore, these performance scales are not adequate capturing descriptive changes in compensatory behavior. Building on the hallmark characteristics of modifying the method of completing daily tasks, Manini and colleagues (2006) created the MOD scale, a hierarchical scale to assess compensatory strategies performed on a battery of daily activities (e.g., chair rising, rising from the floor, stair climbing). The MOD scale objectively captures compensatory strategies by observing individuals perform the activity and ranks them according to severity. For example, rocking forward to rise from a chair would be scored as a low level of compensation and individuals using the arms of the chair to push themselves from a chair would be ranked as having a high level of compensation. The ranking order assumes that as functional deficits increase, an individual will rely on more severe compensatory strategies to complete a task (Marko et al., 2012; Naugle, Higgins, & Manini, 2011). Admittedly, performing these activities under somewhat standard conditions (i.e., in a laboratory setting) might obscure what occurs in the environment and therefore new instruments are needed to evaluate compensatory behaviors across a full spectrum of daily activities.

MOVING TOWARD SHALLOWER WATERS— CONCLUSIONS AND FUTURE DIRECTIONS FOR RESEARCH ON COMPENSATION

A preclinical phase of disability was first proposed by Fried in 1991 and for the past two decades has been continually substantiated by epidemiological research. However, a major gap in the literature exists regarding how the role of compensatory strategies builds on current models of disability and established concepts by Baltes & Baltes to advance efforts to prevent the onset of disability. This manuscript attempts to fill these gaps by providing a comprehensive review of the literature on the use of compensation within the disablement process and how it integrates within the ICF model. A framework for identifying and measuring compensatory changes that underlie the progression of the disablement process was also presented.

Research testing the reliability of Fried's (2000) assessment of activity compensations as a screening tool in different residential settings indicates that these measures can be successfully implemented in the community to detect individuals making early transitions that indicate functional decline (Gibson, Day, Hill, Jolley, Newstead, Cicuttini, Segal, &

Flicker, 2010). However, indices of activity and participation compensations are currently underutilized and overlooked by practitioners using the ICF. There are several obstacles to moving the concept of compensation forward. Therefore, we propose the bulleted items subsequently that are designed to further expose the bottom of the iceberg. The accomplishment of these items are expected to better characterize subtle adaptations prior to the onset of activity limitations and participation restrictions, which will not only aid in understanding the complex disablement process, but help inform the design and implementation of future prevention strategies.

- Expand and refine existing instruments to more accurately and systematically assess compensatory behavior. Measures should differentiate between “activity” and “participation” compensations, as well as “intrinsic” and “extrinsic” strategies to appropriately position an individual’s function in the ICF.
- Develop objective screening criteria for compensatory behaviors that indicate a need for intervention and/or treatment.
- Explore cultural and individual differences in compensatory behaviors and their role in activity limitations and participation. Observational studies of compensatory behaviors across cultures have yet to be conducted.
- Objectively measure compensatory activity and participation in “real” world settings. The majority of existing measures almost exclusively index compensatory behavior during ADL and IADL method and frequency. Therefore, incorporating new technology that recognizes patterns and locations of movement (e.g., accelerometry), multisensor video monitoring systems (Crispim-Junior, Bremond, Joumier, 2012), or daily activity logs could provide novel information regarding compensatory strategies used to perform activities and maintain participation in a person’s natural environment.
- Discover the underlying biopsychosocial mechanisms of compensatory behaviors to maintain activity and participation by conducting experimentally based studies using biomechanical and physiological measures. Psychological and social modes of compensation should also be considered.

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