

1 ABSTRACT

2 *Primary Objective:* To describe the processes involved with developing and implementing a
3 physical activity based health promotion program for people with a brain injury, summarize
4 previous health promotion research efforts, and provide an actual example of a program entitled
5 P.A.C.E, a “Physical Activity Centred Education” program.

6 *Reasoning Behind literature Selection:* Brain injury is serious public health issue due to the
7 incidence, complexity, and high health care costs. Health promotion programmes that
8 incorporate physical activity have been shown to improve the health of people with a disability.
9 However, if programmes are to be successful they have to be appropriately designed otherwise
10 individuals will not adopt and maintain the desired health behaviours.

11 *Main outcomes and results:* Readers will have an understanding of (1) how a theoretical
12 framework drives program development, (2) the strategies required to facilitate behaviour
13 change, (3) how previous research supports the use of a physical activity based health promotion
14 program, and (4) how to implement a program.

15 *Conclusions:* Future research ideas are provided so as to stimulate research in the area of
16 physical activity based health promotion programs for people with a brain injury.

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1 costs ranged from \$600,000 to \$1,875,000 per individual across the lifetime ⁸, and this figure has
2 undoubtedly risen since publication in 1998. Overall annual costs of TBI are estimated to be at
3 \$60 billion ², while stroke is at \$68.9 billion each year in the United States ⁴. These high costs
4 emphasize the importance and need for interventions to improve health and reduce health care
5 costs post injury.

6 Critical goals during the rehabilitation process are to help individuals be able to manage
7 any associated conditions and avoid secondary or chronic conditions developing ⁷. One form of
8 rehabilitation that has consistently been shown to help individuals is health promotion
9 programmes that include physical activity (PA) ^{7,9}. PA is conceptualized as planned exercise
10 (e.g., swimming, weight training, walking) and/or activities of daily living (ADLs) (e.g., cleaning
11 the house, home maintenance, lawn care) ¹⁰ that leads to greater energy expenditure than rest. PA
12 is a leading indicator of health and has been consistently linked with a lower risk of mortality
13 and morbidity ¹⁰. Despite the fact that some rehabilitation programmes include PA based
14 sessions (e.g., aquatics, walking, balance training, strengthening classes), there is no education
15 about (1) why PA is important, (2) social and behavioural strategies to continue PA across the
16 lifespan, and (3) the risks associated with inactivity. This lack of education about PA concepts,
17 guidelines, and definitions suggests a gap in the services provided. Therefore, the purpose of the
18 current paper is provide guidelines for the development and implementation of a health
19 promotion programme that focuses on informational and social/behavioural strategies to
20 facilitate the adoption and maintenance of PA as part of the rehabilitation process post injury.

21 *Developing an Effective Health Promotion Programme*

22 The purpose of a health promotion programme (HPP) is to increase the likelihood that
23 individuals will participate in desired health behaviours by increasing self-efficacy, social

1 support, motivation, and readiness to change ¹¹. For example, a PA education HPP is intended to
2 increase individuals' adoption of and adherence to PA behaviours. This is achieved through an
3 appropriately designed and implemented HPP that (1) increases an individual's intention to
4 change behaviour, and (2) promotes an environment supportive of behaviour change (see Figure
5 1). The USDHHS provides guidelines for creating HPPs that are based on a comprehensive
6 review of the PA intervention literature ¹².

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Insert Figure 1 about here

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10 The first step to implementing a HPP is choosing a target population (e.g., individuals
11 with a brain injury) and creating an 'audience profile' that describes the population in terms of its
12 socio-economic status, needs, common barriers, and lifestyle (e.g., demographic data, current
13 behaviours, previous knowledge, social network). For a HPP focusing on PA education, the
14 audience profile should include information on the target population's previous knowledge of
15 PA, barriers faced to PA (e.g., transportation, cost), and motive for PA participation (e.g.,
16 improve functional independence, positive health outcomes). An effective way to create an
17 audience profile is through the use of quantitative (e.g., questionnaires) and qualitative (e.g.,
18 focus groups, interviews) methods to help identify a population's expectations, intentions, and
19 perceived barriers and motivations ¹¹. Examples of quantitative measures that can be used are
20 outlined below and sample qualitative questions are highlighted in table 1. Each of the measures
21 discussed can be administered at different stages of a programme (e.g., beginning, on-going, pre-
22 post) to provide you with the most relevant information. Results will provide a wealth of

1 information about the wants, needs, barriers, and intention of the target population so that
2 meaningful programme content can be put in place.

3 *Examples of Questionnaires used to Understand the Populations PA Behaviours*

4 The Exercise Stages of Change Scale identifies an individual's current readiness to be
5 active (i.e., pre-contemplation, contemplation, preparation, action, or maintenance) ¹³.
6 Participants are presented with a description of regular exercise (i.e. activity performed three to
7 five times per week for 20-60 minutes per session that causes an increase in breathing rate and
8 sweating) and are asked to choose from five responses related to their level of engagement which
9 represent a stage of change. Pre-contemplation refers to individuals who are not active and do
10 not intend to become active in the foreseeable future (i.e., "No, and I do NOT intend to in the
11 next six months"). Contemplation refers to individuals who are considering becoming active but
12 have not acted on their thoughts (i.e., "No, but I intend to in the next six months"). Preparation
13 refers to individuals who occasionally exercise but not on a regular basis, or those who do not
14 exercise but intend to start soon (i.e., "No, but I intend to in the next 30 days"). Action refers to
15 individuals who have been consistently meeting the guidelines specified for exercise for six
16 months or less (i.e., "Yes, I have been for six months or less"). Maintenance refers to individuals
17 who have been consistently meeting the guidelines specified for exercise for more than six
18 months (i.e., "Yes, I have been for more than six months"). Participants are asked to select one
19 statement that most accurately portrays their exercise habits. The kappa index of reliability for
20 this scale has been reported as .78 for a two-week period ¹³ and has been used with adults with
21 brain injury ¹⁴.

22 Barriers to PA participation can be assessed using the Barriers to Physical Activity Scale
23 for People with Physical Disabilities (B-PADS) ¹⁵. The B-PADS has been used effectively with a

1 variety of groups including African-American women with a physical disability¹⁶, adults with
2 visual and motor impairments¹⁷ and adults post stroke¹⁸. Items determine an individual's
3 interest, perceived importance, and personal or environmental barriers faced when considering
4 PA.

5 Type and amount of PA completed during a typical week can be assessed with the
6 exercise items from the Behavioural Risk Factor Surveillance System survey (USDHHS, 2001).
7 Participants are asked to indicate the frequency of any moderate physical activity (e.g., small
8 increases in heart rate – brisk walking, bicycling, vacuuming, gardening), and/or vigorous
9 physical activity (large increases in breathing or heart rate – running, aerobics, heavy yard work)
10 in the past week by choosing one of five answer choices (“No, away from work I do not do
11 moderate or vigorous level activities for at least 10 minutes at a time”; “Yes, away from work I
12 do vigorous level activities for at least 10 minutes at a time”; “Yes, at work I do vigorous level
13 activities for at least 10 minutes at a time”; “Yes, away from work I do moderate level activities
14 for at least 10 minutes at a time”; “Yes, at work I do moderate level activities for at least 10
15 minutes at a time”). This scale has been used with adults with a traumatic brain injury (TBI)
16 undergoing comprehensive outpatient¹⁴ and long-term outpatient rehabilitation¹⁹

17 Finally, the Exercise Self-Efficacy Scale could be used to measure an individual's
18 confidence in his/her ability to engage in PA in the face of barriers¹³. It is composed of six items
19 assessing an individual's self-efficacy to be active when faced with barriers including (1)
20 negative affect (i.e., “I am under a lot of stress”), (2) excuse making (i.e., “I feel I don't have the
21 time”), (3) must exercise alone (i.e., “I have to exercise alone”), (4) inconvenient to exercise
22 (i.e., “I don't have access to exercise equipment”), (5) resistance from others (i.e., “I am
23 spending time with friends or family who do not exercise”), and (6) bad weather (i.e., “It's

1 raining or snowing”). The scale is scored using a 5-point Likert scale ranging from 1 (*not at all*
2 *confident*) to 5 (*completely confident*). Scores from each item are added and the total score is
3 used. High scores indicate an individual is very confident in his/her ability to engage in PA
4 despite barriers, while low scores indicate low confidence. Test-retest reliability for this scale has
5 been reported as .90 over a two-week period, demonstrating stability of the measure over time¹³.

6 *Curriculum Development and Behaviour Change*

7 Once descriptive and qualitative data is collected from the target population, appropriate
8 curriculum can be tailored to the individual needs of the population. Specifically, programme
9 goals and a curriculum that uses behavioural components to increase the likelihood that
10 participants will achieve the programme goals should be incorporated (see Figure 2).

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12 Insert Figure 2 about here

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14 First, when creating programme goals, the perceived barriers and motivations for the
15 target population should be considered. For example, programme goals focus on the desired
16 knowledge of PA (e.g., impact of PA on rehabilitation outcomes, amount of PA necessary to
17 experience health benefits) and the specific behaviours participants should engage in after
18 completion of the intervention (e.g., regular PA participation according to USDHHS guidelines).

19 Second, when creating curriculum for a HPP the concepts that are necessary for the target
20 population to understand in order to achieve the programme goals (e.g., health benefits
21 associated with PA, positive impact of PA on rehabilitation outcomes) must be identified.

22 Curriculum contents can be further shaped by comparing these concepts to the gaps in
23 knowledge described by the audience profile. In addition to information about specific health

1 behaviours, strategies to facilitate behaviour change must be included (e.g., goal setting, tracking
2 behaviour, self-reward, over coming barriers, etc.)¹¹. The curriculum must also be created with
3 an understanding of the theoretical components behind behaviour change.

4 *Theoretical Framework*

5 Two theoretical frameworks have been used in previous research to facilitate behaviour
6 change within a HPP, including the social cognitive theory (SCT)²⁰ and the Transtheoretical
7 Model²¹. Previous research has adapted the SCT for use in a PA context²²⁻²⁶ and utilized the
8 Transtheoretical Model to describe changes in PA participation^{14, 27-29}. The SCT is useful
9 because it outlines methods to increase self-efficacy, which is helpful when attempting to
10 overcome barriers that may hinder the adoption and maintenance of PA behaviours³⁰. The
11 Transtheoretical Model is often utilized as it depicts how an individual moves from pre-
12 contemplation to maintenance during behaviour change and details how to facilitate this
13 progression²¹.

14 The SCT describes an individual's ability to succeed in various situations, and attributes
15 success in achieving PA-related goals to the interrelationship between an individual's personal,
16 behavioural, and environmental factors²². Bandura²⁰ considers self-efficacy to be an
17 individual's confidence in his/her ability to successfully adhere to a specific behaviour, and it is
18 among the strongest predictors of behaviour change, particularly beginning PA participation and
19 PA adherence^{31, 32}. If self-efficacy is low, an individual believes that (s)he does not have the
20 ability to overcome barriers that hinder PA participation (e.g., participating in PA when the
21 weather is bad, when feeling stressed). As a result, increasing self-efficacy results in an
22 individual feeling more confident in his/her ability to overcome barriers and participate in
23 regular PA (see Figure 3).

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Insert Figure 3 about here

Self-efficacy can be influenced by four antecedents including past performances, social persuasion, vicarious experiences, and psychological states (see Figure 3)³³. HPPs can incorporate strategies that manipulate these antecedents in an effort to increase the self-efficacy and actual participation of individuals. Previous research has shown that individuals with brain injuries face a high number of barriers to PA^{22,34}, resulting in decreased self-efficacy. Consequently, individuals with brain injuries may not engage in PA regularly, contributing to the development of secondary and chronic conditions (e.g., decreased functional strength, decreased endurance)¹⁸. Since self-efficacy is a determinant of PA participation³⁵, increasing self-efficacy in individuals with brain injuries may be particularly effective in increasing PA participation. Repeated efforts to increase self-efficacy are necessary for long-term behaviour change to occur, as behaviour is often variable and inconsistent^{21,36}. The Transtheoretical Model describes the dynamics of this fluctuation in behaviour change.

The Transtheoretical Model depicts behaviour changing progressively through a series of five stages of change (i.e., pre-contemplation, contemplation, preparation, action, and maintenance) (see Figure 4)²¹. Individuals do not simply jump from an early stage in the model to the maintenance stage, but rather move through the stages in order. This progression through the stages is often facilitated with the aid of strategies intended to foster behaviour change (e.g., provide knowledge of benefits of change, develop basic skills needed for change, reinforce successes with rewards)³⁷.

1 less health care utilization (e.g., hospitalization, medication), equaling a cost savings of \$807 per
2 person. These findings demonstrate the ability of well-organized HPPs to positively impact
3 functional ability and significantly lower health care costs.

4 Stuifbergen et al.⁴⁴ investigated the effects of a wellness intervention for women with
5 multiple sclerosis (MS) on self-efficacy (e.g., in relation to PA, responsible health practices,
6 nutrition), health behaviours (e.g., PA, interpersonal relations, stress management), and quality
7 of life (e.g., physical functioning, pain, role limitation) in 113 women with MS (*M age* = 45.79,
8 *SD* = 10.09). The intervention was based on a conceptual model that describes the effect of
9 barriers, resources, and self-efficacy on health behaviours and outcomes. The intervention
10 consisted of a two-phase programme including (1) lifestyle-change classes (e.g., self-assessment
11 of behaviours, resources, and barriers; strategies to increase self-efficacy for health behaviours),
12 and (2) a telephone follow-up for three months. Lifestyle-change classes were presented in a 90-
13 minute session once per week with a double session separated by a lunch break every other
14 Saturday for eight weeks. These classes included topics such as lifestyle adjustment, exercising
15 for fun, and eating healthy. At the conclusion of the lifestyle-change classes, participants
16 received follow-up telephone calls bimonthly from an intervention facilitator who acknowledged
17 their performance accomplishments and encouraged them to continue monitoring goals. Results
18 indicated improvements in self-efficacy, health behaviours, and two aspects of quality of life
19 (QOL) (i.e., pain, mental health) and demonstrated that HPPs including a behaviour change
20 component can improve individuals' long-term health outcomes.

21 Rimmer et al.⁴³ investigated the effectiveness of a 12-week HPP designed for urban
22 African-Americans who had experienced a stroke on health outcome measures (e.g., lipid profile,
23 exercise, dietary fat intake, health behaviour). Thirty-five stroke survivors (9 male, 26 female)

1 ($M = 53.2$, $SD = 8.3$) were included, and reported their most common barriers to PA participation
2 as cost of programme, lack of transportation, lack of energy, and lack of knowledge about
3 location of exercise. The HPP consisted of fitness instruction and exercise, nutrition education,
4 and health behaviour changes and was delivered three days per week (including 45-70 minutes of
5 PA, 60 minutes of nutrition education, and 60-90 minutes of health behaviour education) for 12
6 weeks. Total cholesterol and fat mass decreased while strength, flexibility, and endurance
7 increased. Results emphasized the benefits of a HPP on physical functioning, which impacts
8 secondary and chronic conditions.

9 In another study, Rimmer et. al ¹⁶ examined the effects of a 12-week health promotion
10 intervention on health measures (e.g., exercise, health behaviours, nutrition) of 30 African
11 American women ($M age = 54.9$, $SD = 12.6$). Common barriers to PA participation were also
12 identified (e.g., fatigue, lack of support, lack of transportation). Educational sessions regarding
13 diet, nutrition and health behaviour were provided at no cost to participants and researchers
14 offered free transportation. The participants who completed the intervention (72.5%)
15 demonstrated considerable improvements in health measures (e.g., cardiovascular fitness,
16 muscular strength and endurance, knowledge of nutrition). Results emphasize the effect that the
17 removal of barriers and basic health education can have on PA and health behaviours.

18 In conclusion, HPPs that include PA interventions are beneficial for individuals with
19 disabilities as they facilitate behaviour change, resulting in increased functional ability and lower
20 health care costs ⁴⁹. Regular PA participation has a positive impact on long-term health outcomes
21 ⁴⁴ by increasing various components of physical health and functional ability ⁵⁰ and decreasing
22 the chance of developing secondary and chronic conditions. Among individuals who are already
23 contemplating a PA programme or who are already active, a PA education programme can

1 increase participation significantly by providing additional information ⁴¹ or focusing on removal
2 of barriers ⁴¹.

3 Despite the variety of benefits that accompany participation in a PA education based
4 HPP, there is not one in place for individuals with a brain injury. Therefore, the present paper
5 will discuss a Physical Activity Centred Education (PACE) programme that can be incorporated
6 into the outpatient programme. The aim of the PACE programme is to (1) increase PA self-
7 efficacy, (2) increase intention to change PA behaviours, (3) increase amount of PA completed
8 regularly, and (4) promote positive rehabilitation outcomes.

9 *Example of HPP development: The PACE programme*

10 The PACE programme was developed following the steps recommended by the
11 CDC/USDHHS ^{11,37}. For example, an audience profile was created through the use of
12 quantitative and qualitative methods, and from these results the programme was developed. The
13 initial goal for PACE was that it would be delivered during comprehensive rehabilitation at a
14 local rehabilitation centre where participants would be living at home but attending rehabilitation
15 each day between 9-4pm. PACE would be delivered twice a week (one hour sessions) over a
16 period of eight weeks (see table 2 for detail of weekly topics). The goal of the program was to
17 educate individuals about PA, the relationship between PA and rehabilitation, as well as help
18 individuals learn the social and behavioural skills necessary to adopt and maintain PA
19 participation as part of the rehabilitation process.

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Insert table 2 about here

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1 Specifically, PACE incorporated five behavioural strategies to facilitate the adoption and
2 maintenance of PA behaviours which included (1) goal setting and tracking progress towards
3 goals; (2) creating social support for newly established PA behaviours; (3) employing self-
4 reward to reinforce positive PA behaviours; (4) using problem solving strategies to overcome
5 individual barriers and increase the likelihood of PA maintenance; and (5) maintenance of PA
6 behaviours and prevention of relapse to a sedentary lifestyle. These specific strategies were
7 identified by comparing the components of successful PA education interventions^{49, 51, 52} with
8 the guidelines provided by the USDHHS/CDC^{11, 12} for creating HPPs. The strategies were also
9 influenced by the methods outlined in the SCT for increasing self-efficacy²⁰ and the
10 Transtheoretical Model for increasing intention to change behaviour²¹. Table 3 highlights the
11 components of the PACE program and how they are tied to SCT and the Transtheoretical Model.

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The PACE curriculum was developed with the aid of the director of the outpatient brain
injury programme and a physical therapist working with patients. The programme was intended
to conform to a standardized mode of delivery that included a review of the key educational
components within each session. This was necessary as individuals with brain injuries often
experience disruption of cognitive activities (i.e., recall, memory, and reasoning), difficulty with
sensory processing (i.e., sight and hearing), and inefficiency in communication (i.e.,
understanding presented information and expressing thoughts)⁵³. To aid in the comprehension
and retention of information, PACE curriculum reviewed foundational points every session and
employed multiple modes of delivery. These modes included short information sessions, group

1 discussions (i.e., questions posed based on topics covered to facilitate group application), visual
2 aids (e.g., interactive worksheets, diagrams, etc.), educational games (e.g., matching or fill-in-
3 the-blank activities, etc.), and printed materials (e.g., outlines for each lecture, in-depth
4 information available for each topic, goal-setting and behaviour tracking worksheets, etc.). Each
5 participant received a workbook with all the session materials included (e.g., worksheets
6 intended for participant use during each session, detailed teaching notes for each session
7 included as a resource at the end of the workbook) which served as an educational resource
8 throughout participation in the PACE programme, as well as a long-term reference tool upon
9 discharge.

10 A portion of the PACE materials was piloted so that the researchers became comfortable
11 with the delivery of the materials and the participant group, who were also asked for feedback so
12 that improvements could be made. Five pilot sessions (each with 4-8 participants in attendance)
13 were delivered so that the researchers became more comfortable integrating topics as smoothly
14 as possible. The pilot version of the PACE programme helped to identify how much information
15 was feasible to include in each hour-long session and how much information participants
16 retained from one session to the next (determining the frequency and detail necessary for the
17 successful review of key points). Participants reported that group discussions were easy to follow
18 and were the preferred form of information delivery (versus lecture only). Many participants
19 were also pleased with their ability to understand more complex concepts relating to PA due to
20 the simple format in which they were delivered. All participants reported that PACE sessions
21 helped them understand the importance of PA and the relevance of PA to their rehabilitation.
22 Throughout pre-testing, instructors learned techniques that facilitated more active group
23 discussions. For example, presenting information in the form of case studies and asking

1 questions pertaining to the fictional characters in the studies helped to engage participants.
2 Additionally, having a second instructor participate by offering an answer to a question that the
3 main instructor asked helped participants feel more confident in joining a discussion rather than
4 beginning one.

5 *Future Research*

6 Future research should test the effectiveness of the PACE programme to determine the
7 impact on individuals with a brain injury at different stages of the rehabilitation process. For
8 example, the PACE programme could run during comprehensive outpatient rehabilitation (e.g.,
9 within first year post injury) in a rehabilitation setting (e.g., clinic, hospital) or long-term
10 rehabilitation (e.g., greater than one year post injury) in a community setting (e.g., recreation
11 centre, church). The program could run for eight weeks and assessments of the patient's self-
12 efficacy, stage of change, amount of physical activity, and rehabilitation outcomes (e.g., MPAI-
13 4) could be assessed from pre to post program to determine if there were any changes in physical
14 activity behaviours or rehabilitation outcomes. Furthermore, PACE participants could complete
15 the same measures at different stages post discharge (e.g., at 3, 6, 9, and 12 months) in order to
16 detect the maintenance of change over time. In addition, a control group consisting of individuals
17 with a brain injury who do not participate in the PACE programme should complete the same
18 measures (i.e. Exercise Self-Efficacy Scale; Exercise Stage of Change Scale; Amount and
19 Intensity of PA; Rehabilitation outcomes) at different stages of the rehabilitation programme
20 also. Results from the control group can then be compared with the results of the participants
21 who were involved in the PACE programme, and differences in scores can be attributed to
22 participation in the PACE programme.

1 Table 1: Qualitative questions to better understand individual's physical activity
 2 behaviours
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Question Area	Questions
Knowledge	What does the term physical activity mean to you? What is the difference between PT and physical activity? What types of physical activities should people conduct? Can you describe these activities for me? Are you familiar with national guidelines for physical activity sufficient for a health benefit?
Expectations	What are the top 3 health benefits associated with physical activity participation? Which health benefits are most important to you? Why are those health benefits most important to you?
Expectations	How much physical activity do you need to complete to get those health benefits? How realistic is it that you complete that amount of PA? What barriers are preventing you from engaging in PA? I can't set and stick to goals I don't have the social support I need I'm not motivated enough I don't have the time or resources (equipment, too tired, accessible facility) I don't have the money I don't have enough confidence I don't know enough about how to do the exercise? Use the machines? Design a workout? How much physical activity do you think you will be able to complete?
Attitude	Is physical activity something you should do as a part of your rehabilitation? What role does physical activity play in your rehabilitation process? What role does physical activity play in helping you overcome secondary health issues throughout your rehabilitation? (plan, range of motion, weight management, depression) Why would you not be physically active? (is it painful, not good for me?)
Expectations	What do you hope to learn during rehabilitation to help you be physically active once you are discharged? What types of physical activity I should do? The amount of physical activity I should do? Where should I go to be physically active? How to set goals? How to overcome barriers? How to create a social support network?

	What would you like to learn?
Expectations	Do you intend to be physically active once you leave rehabilitation? Why or why not? Do you have long-term physical activity goals? (1yr, 2yr, etc) Who are you most likely to be physically active with? Where do you think you will be physically active?
Motivation	What are the main motivating factors for you to be physically active? What are your top 3 motivating factors? Why do these factors motivate you?
Barriers	What 3 things do you need to help you be physically active in the future? I need more skills-goal setting? Someone to show me how to do it? Support from others? Someone to be physically active with? Greater Motivation? Resources? (equipment, transport, accessible facility)
Intention	Were you physically active before the injury? Were you physically active enough to meet the guidelines? Do you want physical activity to be a part of your life in the future?

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Table 2: Summary of PACE Content

Week 1	Introduction to PA
Week 2	Exercise is Medicine
Week 3	Goal-Setting and Overcoming Barriers
Week 4	Tracking Behaviour and Self-Reward
Week 5	Managing Frustration and Discouragement
Week 6	PA, Quality of Life, and Community Involvement
Week 7	Re-evaluating Goals
Week 8	How to Maintain Health Habits

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Table 3: Interaction of PACE Components with Behavioural Theories

COMPONENT OF PACE	TRANSTHEORETICAL MODEL	SOCIAL COGNITIVE THEORY
Definition and importance of PA	Belief in importance of desired behaviour essential in moving from “pre-contemplation” through stages to “action”	
Impact on PA on health outcomes	Belief in importance of desired behaviour essential in moving from “pre-contemplation” through stages to “action”	
Impact of PA on	Belief in importance of desired	

conditions associated with brain injury	behaviour essential in moving from “pre-contemplation” through stages to “action”	
Goal-setting and evaluation of goals	Gives practical and realistic steps to incorporate PA into lifestyle, moving from “contemplation” or “preparation” to “action”	Draws self-efficacy from past performance and physiological state
Identifying potential barriers & creating strategies to overcome them	Equips individuals to prevent reverting to an earlier SOC	Draws self-efficacy from past performance
Role of self-efficacy in behaviour change; how to increase self-efficacy	Teaches individuals to increase self-efficacy, which increases likelihood of moving forward through SOC	Teaches individuals multiple ways to increase self-efficacy
Becoming aware of the environment	Teaches individuals to anticipate potential barriers that may result in reverting to an earlier SOC and create potential solutions	
Looking to others to gather experience and support		Increases self-efficacy through social persuasion and vicarious experiences
Instruction on how to progress to the next SOC	Gives practical and realistic steps for moving forward through SOC	
Self-reinforcement to make behaviour change more likely and permanent and keep motivation high (i.e., rewards, social participation)	Increases individuals’ motivation to move forward through SOC and prevent reverting to an earlier SOC	Increases self-efficacy through past performance, vicarious experiences, social persuasion, and physiological state
How to maintain a habit of regular PA	Practical tips to move from “action” to “maintenance”	Practical tips to continue to increase self-efficacy

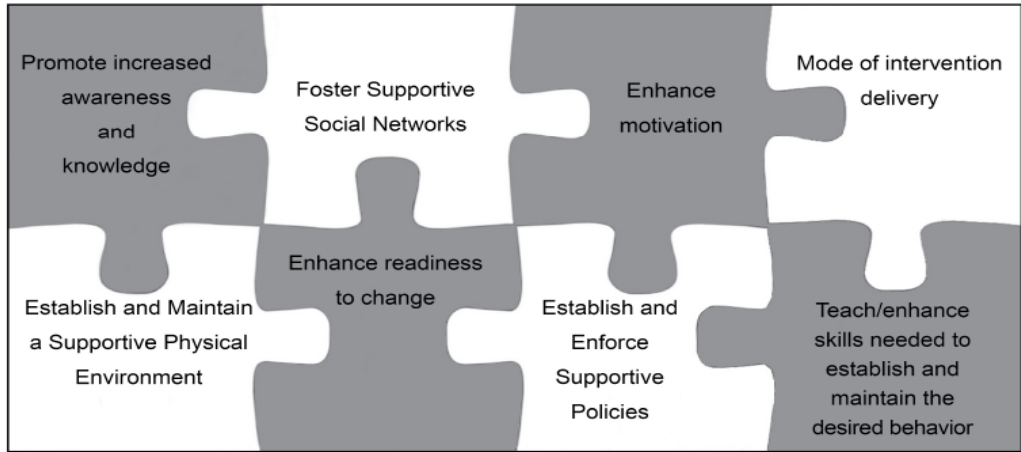
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Figure 1: The Intervention Puzzle. Modified from USDHHS, 1999



KEY

■ Strengthening individual intention to change

□ Creating an environment supportive of change

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18 *Figure 2: Components of a PA Intervention. (USDHHS, 2008).*

Intervention Components	Reason Included	Examples
Providing knowledge of the importance of PA	Demonstrates importance of the issue to participants – increases likelihood that they will pay attention to information and seriously consider behaviour change	Relationship to rehabilitation, healthy lifestyle, etc.
Dispelling misconceptions about PA	Aids in breaking down some common barriers that may prevent individuals from becoming active	“Exercise isn’t fun, it’s hard work”, “I could easily hurt myself participating in PA, so it’s not worth it”
Developing supportive social networks	Teaches individuals to analyze their social influences (positive and negative) and recognize relationships that may aid in achieving PA goals	Use a buddy system for encouragement, involve significant others in goal setting, etc.
Enhancing motivation to participate	Motivation is the factor that determines whether or not an individual will actually follow through with a desired behaviour	Recommend personal goals that relate to the lifestyle and values of each participant, involve a spokesperson that the target audience can identify with and trust, etc.
Overcoming barriers in physical environment	Aids in breaking down some common barriers that may prevent individuals from becoming active	Provide a list of well-lit safe walking paths in the community, provide transportation to accessible facilities, etc.
Increasing readiness to change	Assessing individuals’ readiness to change helps instructors individualize the information presented	Assess current stage of change, provide strategies needed to progress through the stages
Teaching and practicing skills to initiate and maintain new behaviours	Equips individuals to move into and remain in the maintenance phase after leaving the PACE programme	Develop a list of resources in the community, incorporate “how-to” materials and videos, etc.

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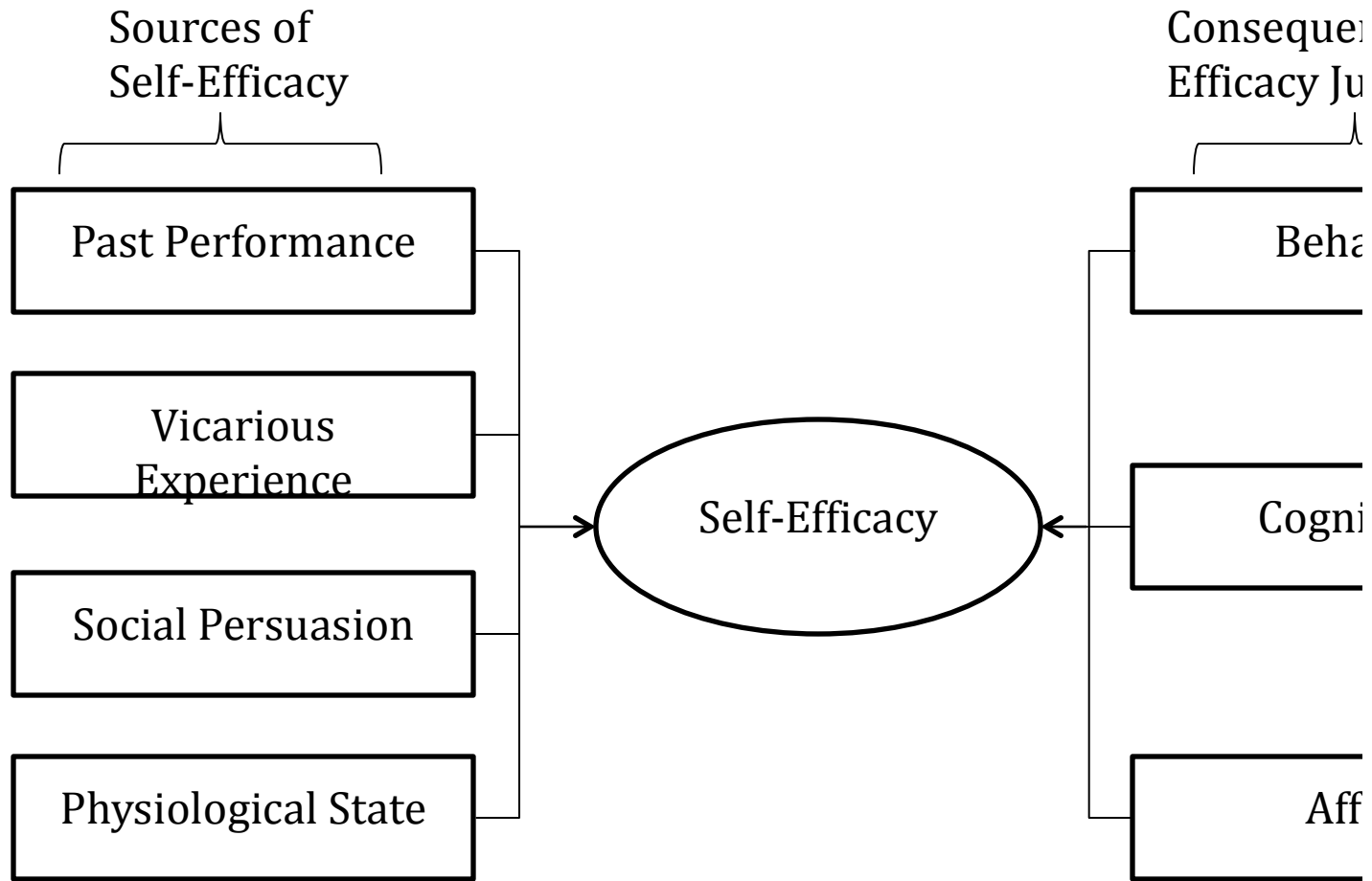
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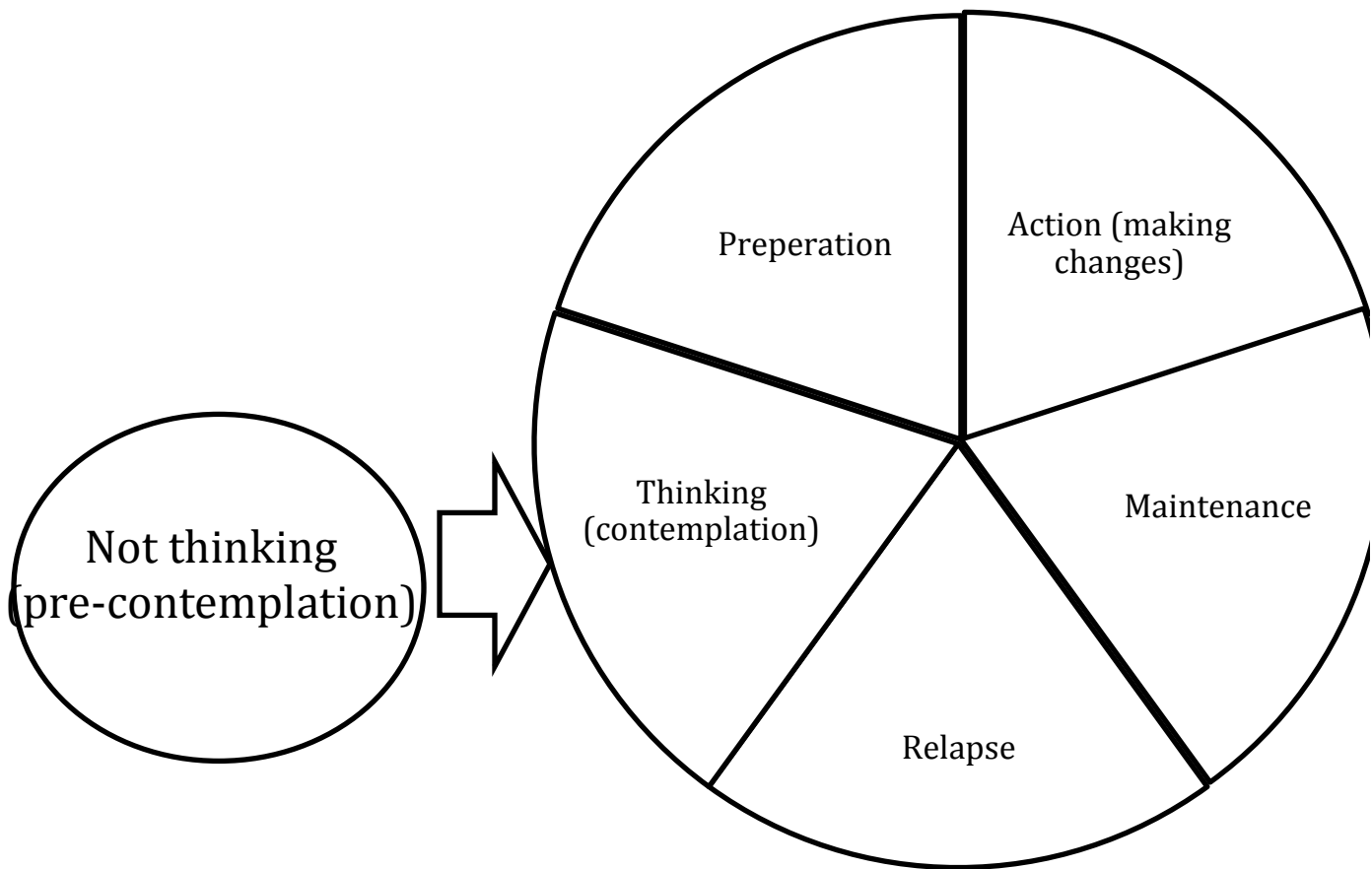
9 *Figure 3: Bandura’s Self-efficacy Theory, 1986*



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Figure 4: The Stages of Behaviour Change and the Transtheoretical Model. Adapted from Prochaska & DiClemente, 1983.



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References

- [1] Faul MXL, Wald MM, Coronado VG. Traumatic brain injury in the united states: Emergency department visits, hospitalizations, and deaths. Centers for Disease Control and Prevention, National Center for Injury Prevention and Control 2010.
- [2] Finkelstein E, Corso P, Miller T. The incidence and economic burden of injuries in the united states. New York: Oxford University Press; 2006.
- [3] Kalpakjian , Lam , Toussaint , Hansen Merbitz . Describing quality of life and psychosocial outcomes after traumatic brain injury. American Journal of Physical Medicine & Rehabilitation 2004;83(4):255-65.
- [4] Lloyd-Jones D, Adams R, Carnethon M, et al. Heart disease and stroke statistics - 2009 update. A report from the American heart association statistics committee and stroke statistics subcommittee. Circulation 2009;119:21-181.
- [5] Heron MP, Hoyert DL, Murphy SL, Xu JQ, Kochanek KD, & Tejada-Vera B. Deaths: Final data for 2006. National Vital Statistics Reports 2009;57(14):1-15.
- [6] National Institute of Neurological Disorders and Stroke. Traumatic brain injury: Hope through research. National Institutes of Health 2002;NIH Publication No.: 02-158.
- [7] Rimmer JH, Rowland JL. Health promotion for people with disabilities: Implications for empowering the person and promoting disability-friendly environments. American Journal of Lifestyle Medicine 2008.
- [8] National Institute of Health. Rehabilitation of person's with traumatic brain injury. NIH Consensus Statement 1998 Oct 26-28;16:1-41.

- 1 [9] Donald J. Lollar, John E. Crews. Redefining the role of public health in disability. Annual
2 Review of Public Health 2003;24:195.
3
- 4 [10] U.S. Department of Health and Human Services. (2009). *2008 physical activity guidelines*
5 *for Americans*. Retrieved April 1, 2011, from
6 <http://www.health.gov/PAGuidelines/pdf/paguide.pdf>
7
- 8 [11] Brown D, Heath GW, and Martin SL. Promoting physical activity: A guide for community
9 action (2nd edition). Champaign, IL: Human Kinetics; 2010.
10
- 11 [12] Kahn EB, Ramsey LT, Brownson RC, Heath GW, Howze EH, Powell KE, Stone EJ, Rajab
12 MW, Corso P. The effectiveness of interventions to increase physical activity. A systematic
13 review. American Journal of Preventive Medicine 2002;22(4 Suppl):73-107.
14
- 15 [13] Marcus BH, Selby VC, Niaura RS, Rossi JS. Self-efficacy and the stages of exercise
16 behavior change. Research Quarterly for Exercise & Sport 1992;63(1):60-66.
17
- 18 [14] Ede A, Buddhadev H, Irwin K, & Driver S. Circuit training for individuals with a traumatic
19 brain injury. Journal of Strength and Conditioning 2011; 33(4):48-51.
20
- 21 [15] Heller T, Timmer JH, Rubin S. Exercise and nutrition education curriculum for adults with
22 developmental disabilities. Barriers Scale in T. Heller, B.A. Marks, and S.H. Ailey 2001.
23
- 24 [16] Rimmer JH, Rubin SS, Braddock D. Barriers to exercise in african american women with
25 physical disabilities. Archives of Physical Medicine and Rehabilitation 2000;81(2):182-8.
26
- 27 [17] Kirchner CE, Gerber EG, Smith BC. Designed to deter: Community barriers to physical
28 activity for people with visual or motor impairments. American Journal of Preventive Medicine
29 2008;34(4):349-52.
30
- 31 [18] Rimmer JH, Wang E, Donald Smith. Barriers associated with exercise and community
32 access for individuals with stroke. Journal of Rehabilitation Research & Development
33 2008;45(2):315-22.
34
- 35 [19] Driver S. What barriers to physical activity do outpatients with a traumatic brain injury
36 face? Journal of Cognitive Rehabilitation 2009;33:4-10.
37
- 38 [20] Bandura A. Social foundations of thought and action: A social cognitive theory. Englewood
39 Cliffs, NJ: Prentice-Hall; 1986.
40

- 1 [21] Prochaska JO, DiClemente CC. Stages and processes of self-change of smoking: Toward an
2 integrative model of change. *Journal of Consulting and Clinical Psychology* 1983;390-395.
3
- 4 [22] Driver S. Applying physical activity motivation theories to people with brain injuries.
5 *Adapted Physical Activity Quarterly* 2006;23(2):148-62.
6
- 7 [23] Lox CL, Freehill AJ. The impact of pulmonary rehabilitation on self-efficacy, quality of life,
8 and exercise tolerance. *Rehabilitation Psychology* 1999;44:1-14.
9
- 10 [24] Martin J. Training and performance self-efficacy, affect, and performance in wheelchair
11 road racers. *The Sport Psychologist* 2002;16:384-95.
12
- 13 [25] McAuley E. The role of efficacy cognitions in the prediction of exercise behavior in middle-
14 aged adults. *Journal of Behavioral Medicine* 1993;16:103-13.
15
- 16 [26] McAuley E, Blissimer B. Self-efficacy determinants and consequences of physical activity.
17 *Exercise and Sport Sciences Reviews* 2000;28(2):85-8.
18
- 19 [27] Dishman RK, Vandenberg RJ, Motl RW, Nigg CR. Using constructs of the transtheoretical
20 model to predict classes of change in regular physical activity: A multi-ethnic longitudinal cohort
21 study. *Annals of Behavioral Medicine* 2010;40(2):150-63.
22
- 23 [28] Kirk A, MacMillan F, Webster N. Application of the transtheoretical model to physical
24 activity in older adults with type 2 diabetes and/or cardiovascular disease. *Psychology of Sport &*
25 *Exercise* 2010;11(4):320-4.
26
- 27 [29] Pekmezi D, Barbera B, Marcus BH. Using the transtheoretical model to promote physical
28 activity. *ACSM's Health & Fitness Journal* 2010 Jul;14(4):8-13.
29
- 30 [30] Nahas MV, Goldfine B, Collins MA. Determinants of physical activity in adolescents and
31 young adults: The basis for high school and college physical education to promote active
32 lifestyles. *The Physical Educator* 2003;48:42-56.
33
- 34 [31] Haworth J, Young C, Thornton E. The effects of an 'exercise and education' programme on
35 exercise self-efficacy and levels of independent activity in adults with acquired neurological
36 pathologies: An exploratory, randomized study. *Clinical Rehabilitation* 2009;23(4):371-83.
37
- 38 [32] Reuter T, Ziegelmann JP, Wiedemann AU, Geiser C, Lippke S, Schuz B, Schwarzer R.
39 Changes in intentions, planning, and self-efficacy predict changes in behaviors. *Journal of Health*
40 *Psychology* 2010;15(6):935-47.
41

- 1 [33] Bandura A. Social foundations of thought and action: A social cognitive theory. Englewood
2 Cliffs, NJ: Prentice-Hall; 1986.
3
- 4 [34] Driver S, Ede A, Warren AM, Stevens L. What barriers to physical activity do individuals
5 with brain injuries face? Manuscript under review.
6
- 7 [35] Bandura A. Self-efficacy: The exercise of control. New York: Freeman; 1997.
8
- 9 [36] Grodesky JM. "Somebody needs to light a firecracker under me!": Understanding the
10 meaning of physical activity and exercise for older adults. *Journal of Ethnographic and*
11 *Qualitative Research* 2008;2:100-110.
12
- 13 [37] USDHHS. Promoting physical activity: A guide for community action. Champaign, IL:
14 Human Kinetics; 1999.
15
- 16 [38] Abdullah N, Horner-Johnson W, Drum CE, Krahn GL, Staples E, Weisser J, Hammond L.
17 Healthy lifestyles for people with disabilities. *Californian Journal of Health Promotion*
18 2004;2(Special Issue: Oregon):42-54.
19
- 20 [39] Ravesloot C, Seekins T, White G. Living well with a disability health promotion
21 intervention: Improved health status for consumers and lower costs for health care
22 policymakers. *Rehabilitation Psychology* 2005;50(3):239-245.
23
- 24 [40] Ravesloot C, Seekins T, Cahill T. Health promotion for people with disabilities:
25 Development and evaluation of the living well with a disability program. *Health Education*
26 *Resource* 2007;22:522-531.
27
- 28 [41] Rimmer JH, Braddock D. Health promotion for people with physical, cognitive and sensory
29 disabilities: An emerging national priority. *American Journal of Health Promotion* 2002;16:220-
30 224.
31
- 32 [42] Rimmer JH, Silverman K, Braunschweig C, Quinn L, Liu Y. Feasibility of a health
33 promotion intervention for a group of predominantly african american women with type 2
34 diabetes. *The Diabetes Educator* 2002;28(4):571-580.
35
- 36 [43] Rimmer JH, Braunschweig C, Silverman K, Riley B, Creviston T, Nicola T. Effects of a
37 short-term health promotion intervention for a predominantly african-american group of stroke
38 survivors. *American Journal of Preventative Medicine* 2000;18(4):332-338.
39
- 40 [44] Stuijbergen AK, Becker H, Blozis S, Timmerman G, Kullberg V. A randomized clinical
41 trial of a wellness intervention for women with multiple sclerosis. *Archives of Physical Medicine*

- 1 Rehabilitation 2003;84:467-476.
2
- 3 [45] Rimmer JH, Rowland JL. Health promotion for people with disabilities: Implications for
4 empowering the person and promoting disability-friendly environments. American Journal of
5 Lifestyle Medicine 2008.
6
- 7 [46] Antonovsky A. *Health, stress, and coping: New perspectives on mental and physical well-*
8 *being*. San Francisco: Jossey Ball; 1979.
9
- 10 [47] Abramson LY, Seligman MEP, Teasdale JD. Learned helplessness in humans: Critique and
11 reformulation. Journal of Abnormal Psychology 1978;87:49-74.
12
- 13 [48] Snyder CR, Irving LM, Anderson JR. Hope and health. In: Handbook of social and clinical
14 psychology: The health perspective. Elmsford, N.Y: Pergamon Press, Inc.; 1991. p 285-305.
15
- 16 [49] Ravesloot C, Seekins T, Cahill T. Health promotion for people with disabilities:
17 Development and evaluation of the living well with a disability program. Health Education
18 Resource 2007;22:522-531.
19
- 20 [50] Rimmer JH, Braunschweig C, Silverman K, Riley B, Creviston T, Nicola T. Effects of a
21 short-term health promotion intervention for a predominantly african-american group of stroke
22 survivors. American Journal of Preventative Medicine 2000;18(4):332-338.
23
- 24 [51] Gillis D, McLellan B, Sperber N, Tuzzio L, Verboncoeur C, & Stewart A. Community
25 healthy activities model program for seniors II (CHAMPS II): Program manual. San Francisco,
26 CA: University of California, San Francisco: Institute for Health & Aging; 2003.
27
- 28 [52] Stuijbergen AK, Becker H, Blozis S, Timmerman G, Kullberg V. A randomized clinical
29 trial of a wellness intervention for women with multiple sclerosis. Archives of Physical Medicine
30 Rehabilitation 2003;84:467-476.
31
- 32 [53] National Institute of Neurological Disorders and Stroke. Traumatic brain injury: Hope
33 through research. 2002 Feb.;NIH Publication No.: 02-158.
34
35