

Date: February 21, 2013

Title: Vital Sign Monitoring in Children and Adolescents who are Overweight or Obese in the Outpatient Physical Therapy Clinic

Clinical Question:

- | | |
|------------------------|--|
| P (Population/Problem) | Among children and adolescents who are overweight or obese |
| I (Intervention) | does monitoring patient cardiovascular tolerance* during a physical therapy session utilizing vital signs* |
| C (Comparison) | versus standard care |
| O (Outcome) | reduce the risk of adverse events*? |

[Definitions for terms marked with * may be found in the Supporting Information section.](#)

Target Population for the Recommendation:

Children and adolescent patients ages 5 to 18 years with body mass index (BMI) > 85th percentile in the outpatient physical therapy setting.

Recommendation:

It is recommended that vital signs be assessed prior to and during physical therapy treatment sessions in order to monitor cardiovascular system tolerance to an exercise intervention in children and adolescent patients who are overweight or obese (Carletti et al. 2008 [3a]; Gaya et al. 2009 [4a]; Hayes and Eisenmann 2011 [4a]; Norman et al. 2005 [4a]; Ribeiro et al. 2003 [4b]).

Discussion/Synthesis of Evidence related to the recommendations:

High blood pressure and high BMI in children and adolescents have been linked to decreasing exercise tolerance compared to their normal weight peers (Carletti et al. 2008 [3a]; Gaya et al. 2009 [4a]; Hayes and Eisenmann 2011 [4a]; Norman et al. 2005 [4a]; Ribeiro et al. 2003 [4b]). One controlled clinical trial, one cross-sectional study, and several cohort prospective studies examined the change in resting heart rate, maximal heart rate, blood pressure, and volume of oxygen uptake (VO₂) at lactate threshold during maximal exertion (Carletti et al. 2008 [3a]; Hayes and Eisenmann 2011 [4a]; Gaya et al. 2009 [4a]; Leary 2007 [4a]; Norman et al. 2005 [4a]; Ribeiro et al. 2003 [4b]). Children and adolescents who are overweight or obese were found to have greater cardiovascular demand including increased blood pressure (systolic and diastolic), heart rate, and oxygen consumption in comparison to their normal weight peers during exercise in the maximal effort phase (Carletti et al. 2008 [3a]; Hayes and Eisenmann 2011 [4a]; Gaya et al. 2009 [4a]; Leary 2007 [4a]; Norman et al. 2005 [4a]; Ribeiro et al. 2003 [4b]). Adolescents who were overweight or obese had significantly increased arterial blood pressure during a graded treadmill test as well as greater cardiovascular demand in resting and at maximal exertion than normal weight adolescents of the same age group (Carletti et al. 2008 [3a]). Effort at maximal exertion was significantly different in males in this group with males who were overweight having significantly increased arterial pressure compared to normal weight males, normal weight females, and overweight and obese females (Carletti et al. 2008 [3a]).

Children and adolescents who are overweight demonstrated increased resting heart rate and a lower maximal heart rate versus non-overweight adolescents (Norman et al. 2005 [4a]). Furthermore, these two groups (overweight and non-overweight) had similar absolute VO₂ at lactate threshold and maximal exertion during a cycle ergometer test and during a walk/run test. However, the overweight group demonstrated greater oxygen uptake, greater use of their cardiorespiratory reserve, and increased metabolic demands. The adolescents who were overweight required greater energy during submaximal exercise and required greater oxygen consumption (Norman et al. 2005 [4a]). The greater the energy required during exercise trended toward the decreased ability to sustain exercise as long as their non-overweight peers (Norman et al. 2005 [4a]).

Based on the synthesis of the aforementioned evidence, monitoring vital signs during a physical therapy treatment session to guide treatment to ensure children and adolescents are below the lactate threshold, are within target heart rate, and are within safe ranges of systolic and diastolic blood pressure may allow greater tolerance to exercise and reduce risk of adverse events in the physical therapy clinic.

Reference List:

- Carletti, L., Rodrigues, A. N., Perez, A. J., Vassallo, D.V.: Blood pressure response to physical exertion in adolescents: influence of overweight and obesity. *Arq Bras Cardiol*, 91(1): 24-28, 2008. [3a]
- Childhood overweight and obesity. Center for Disease Control website. 2012. Available at: <http://www.cdc.gov/obesity/childhood/index.html>. Accessed November 8, 2012. [5a]
- Demorest, R. A., Reginald, L.: Athletic participation by children and adolescents who have systemic hypertension. *Pediatrics*, 125(6): 1287-1294, 2010. [5a]
- Dunbar, C. C., Robertson, R.J., Baun, R., Blandin, M.F., Metz, K., Goss, F.L.: The validity of regulating exercise intensity by ratings of perceived exertion. *Medi Sci Sports Exerc*, 24(1): 94-99, 1992. [4b]
- Frese, E.M., Fick, A., Sadowsky, H. S.: Blood pressure measurement guidelines for physical therapists. *Cardiopulm Phys Ther J*, 22(2): 5-12, 2011. [5a]
- Ganley, K.J., Paterno, M.V., Miles, C. Stout, J., Brawner, L., Girolami, G., Warren, M.: Health-related fitness in children and adolescents. *Pediatr Phys Ther*, 23(3): 208-220, 2011 [5a]
- Gaya, A. R., A. Alves, Aires, L., Martins, C.L., Ribeiro, J.C., Mota, J.: Association between time spent in sedentary, moderate to vigorous physical activity, body mass index, cardiorespiratory fitness and blood pressure. *Ann Hum Biol*, 36(4): 379-387, 2009. [4a]
- Hayes, H.M., Eisenmann, J.C.: Joint association of fatness and physical activity on resting blood pressure in 5 to 9 year old children. *Pediatr Exerc Sci*, 23: 97-105, 2011. [4a]
- Leary, S.D., Ness, A.R., Smith, G.D., Mattocks, C., Deere, K. Blair, S.N., Riddoch, C.: Physical activity and blood pressure in childhood: findings from a population based study. *Am Heart Assoc (Hypertension)*, 51: 92-98, 2008. [4a]
- Marinov, B, Kostianev, S, Turnovska, T.: Ventilatory efficiency and rate of perceived exertion in obese and non-obese children performing standardized exercise. *Clin Physiol Funct Imaging*, 22(4): 254-260, 2002. [4a]
- National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents: The fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents. *Pediatrics*, 114(2 Suppl 4th Report): 555-76, 2004. [5b]
- Norman, A. C., Drinkard, B., McDuffie, J.R., Ghorbani, S., Yanoff, L.B., Yanovski, J.A.: Influence of excess adiposity on exercise fitness and performance in overweight children and adolescents. *Pediatrics*, 115(6): 690-696, 2005. [4a]
- Ribeiro, J., Guerra, S., Pinto, A., Oliveira, J., Duarte, J., Mota, J.: Overweight and obesity in children and adolescents: relationship with blood pressure, and physical activity. *Ann Hum Biol*, 30(2): 203-213, 2003. [4b]
- Roeminch, J.N., Barkley, J.E., Epstein, L.H., Lobarinas, C.L., White, T.M., Foster, J.H.: Validity of PCERT and OMNI walk/run ratings of perceived exertion. *Med Sci Sports Exerc*, 38(5):1014-1019, 2006. [4a]
- Torrance, B., McGuire, KA, Lewanczuk, R, McGavock, J.: Overweight, physical activity, and high blood pressure in children: a review of the literature. *Vasc Health Risk Manag*, 3(1): 139-149, 2007. [5b]

IMPLEMENTATION

Applicability Issues:

Vital signs can be used to monitor tolerance of exercise and guide outpatient physical therapy treatment for children and adolescents that are overweight or obese. For example, if a patient's blood pressure, heart rate, and respiration rate rise unexpectedly and their rate of perceived exertion (RPE) is higher than the goal for that treatment session, a rest break may be warranted or a change in level of exercise to return vital signs to the patient's baseline level. With monitoring vital signs, the therapist will be able to track if certain exercises are increasing vital signs too rapidly and in turn, decrease the ability of the patient to perform the exercise. With the therapist monitoring the vital signs and subjective RPE, the therapist can ensure that the patient's physiological and psychological response is within an appropriate range for the goal of the treatment session.

Cost: There may be cost associated with obtaining manual blood pressure cuffs, stethoscopes, or electronic (oscillating) blood pressure devices and training staff to use a RPE scale.

Staff Education: Physical therapists and physical therapist assistants are currently trained in vital sign measurement through their Master or Doctor of Physical Therapy programs or their physical therapist assistant program as part of the requirements established by their governing organization, the American Physical Therapy Association. A guideline for blood pressure measurement by physical therapists was developed by Frese et al. (2011 [5a]). Physical therapists will need to be trained in administering and monitoring a RPE scale (*Dunbar et al. 1992 [4b]; Marinov et al. 2002 [4a]; Roeminch et al. 2006 [4a]*).

Equipment: Examples of equipment needed include an oscillometric machine (e.g. Dinamap), electronic forearm blood pressure cuff, or manual blood pressure cuff with stethoscope. Obese children and adolescents may need an adult size blood pressure cuff or a thigh cuff to ensure a good fit and accurate measurement (*National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents 2004 [5b]*).

Relevant CCHMC Tools for Implementation:

BEST 023: Blood Pressure Measurement in Children

Outcome or Process Measures:

Patient vital signs: Blood pressure, heart rate, respiration rate, and oxygen saturation.

Patient exertion level: This can be measured by a rate of perceived exertion scale (RPE). Examples of a RPE scale include the Borg RPE scale and the Pictorial Children's Effort Rating Table (PCERT) scale (*Dunbar et al. 1992 [4b]; Marinov et al. 2002 [4a]; Roeminch et al. 2006 [4a]*). These subjective scales based on patient report can be used in conjunction with objective measures such as vital signs to use as a tool to further evaluate patient response to treatment.

Patient safety: This can be measured through referrals to physicians for unstable vitals taken during a physical therapy session or hypertension or hypotension noted during a physical therapy session or through activation of an emergency management system (EMS).

Improved tolerance: To physical therapy session (fewer rest breaks) as measured by clinician report and demonstrated via clinical documentation.

SUPPORTING INFORMATION

Background/Purpose of BEST Development:

Obesity is an emerging epidemic in the United States of America, not only among adults, but also among children and adolescents. Pediatric obesity is one of the most talked about health care issues affecting children in the United States. Seventeen percent of children, or approximately 12.5 million children, in the nation are now obese and almost one-third are overweight (*Ganley et al. 2011 [5a]; www.cdc.gov [5a]*). Overweight for children and adolescents is defined as Body Mass Index (BMI) in the 85th to 95th percentile and obese for children and adolescents is defined as BMI above the 95th percentile (*Ganley et al. 2011 [5a]; www.cdc.gov [5a]*). Children who are overweight or obese as young as five years old

can develop co-morbidities such as elevated blood pressure, hypertension, and cardiovascular disease and these factors may follow this population into adulthood (Frese et al. 2011 [5a]; Ganley et al. 2011 [5a]; Gaya et al. 2009 [4a]; www.cdc.gov [5a]). Higher BMI, higher adiposity, and increased sedentary behavior (low physical activity levels) may lead to increased cardiovascular and cardiorespiratory ailments including increased resting heart rate, increased systolic blood pressure, lower maximum heart rate, increased oxygen consumption, and increased cardiorespiratory effort (Carletti et al. 2008 [3a]; Demorest and Reginald, 2010 [5a]; Gaya et al. 2009 [4a]; Hayes and Eisenmann 2011 [4a]; Norman et al. 2005 [4a]; Ribeiro et al. 2003 [4a]). Physical activity and BMI may be independent predictors of systolic blood pressure and BMI may be a predictor for diastolic blood pressure (Gaya et al. 2009 [4a]). Children who participate in moderate to vigorous physical activity and have high adiposity may have lower blood pressure than those children who had low participation rates in moderate to vigorous physical activity and high adiposity (Gaya et al. 2009 [4a]; Hayes and Eisenmann 2011 [4a]). Furthermore, increased physical activity may be associated with lower systolic blood pressure and moderate to vigorous physical activity was linked to even greater reductions in systolic blood pressure even when factoring for confounding variables such as age and gender (Leary et al. 2007 [4a]). Understanding the connection between higher BMI among children and adolescents, physical activity levels, cardiovascular response to exercise is imperative in the physical therapy clinic as the main focus is exercise. Utilizing vital signs to alter course of treatment based on cardiovascular response may be one tool to help a clinician guide exercise intervention in a physical therapy clinic.

Definitions:

Vital signs: signs of life; including but not limited to blood pressure, heart rate, respiration rate (Merriam-Webster Dictionary)

Guide: something that provides someone with directing or guiding information (Merriam-Webster Dictionary)

Tolerance: the capacity of the body to endure (Merriam-Webster Dictionary)

Adverse events: outcomes including but not limited to excessive fatigue, hypotension, hypertension, syncope, loss of consciousness, shortness of breath

Search Strategy:

Databases: PubMed, Medline, Cochrane Library, CINAHL, SPORTDiscus.

Search Terms: Obesity, pediatric, exercise, resistance exercise, rate of perceived exertion, children, youth, adolescents, vital sign(s), physical therapy, physiotherapy. The references of the studies meeting the search criteria were then hand-searched.

Filters: English language, no date filter

Search Dates: July 26, 2012-November 8, 2012

Relevant CCHMC Evidence-Based Documents:

BEST #023: Blood Pressure Measurement in Children

Group/Team Members:

Group/Team Leader: Amber Boyd, PT, DPT, CSCS, Team Leader, Division of Occupational Therapy and Physical Therapy
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Conflicts of Interest were declared for each team member:

- No financial or intellectual conflicts of interest were found.
- No external funding was received for development of this BEST.
- The following conflicts of interest were disclosed:

Note: Full tables of the [LEGEND evidence evaluation system](#) are available in separate documents:

- [Table of Evidence Levels of Individual Studies by Domain, Study Design, & Quality](#) (abbreviated table below)
- [Grading a Body of Evidence to Answer a Clinical Question](#)
- [Judging the Strength of a Recommendation](#) (dimensions table below)

Table of Evidence Levels (see note above):

Quality level	Definition
1a† or 1b†	Systematic review, meta-analysis, or meta-synthesis of multiple studies
2a or 2b	Best study design for domain
3a or 3b	Fair study design for domain
4a or 4b	Weak study design for domain
5a or 5b	General review, expert opinion, case report, consensus report, or guideline
5	Local Consensus

†a = good quality study; b = lesser quality study

Table of Language and Definitions for Recommendation Strength (see note above):

Language for Strength	Definition
It is strongly recommended that... It is strongly recommended that... not...	When the dimensions for judging the strength of the evidence are applied, there is high support that benefits clearly outweigh risks and burdens. (or <i>visa-versa</i> for negative recommendations)
It is recommended that... It is recommended that... not...	When the dimensions for judging the strength of the evidence are applied, there is moderate support that benefits are closely balanced with risks and burdens.
There is insufficient evidence and a lack of consensus to make a recommendation...	
<i>Given the dimensions below and that more answers to the left of the scales indicate support for a stronger recommendation, the recommendation statement above reflects the strength of the recommendation as judged by the development group. (Note that for negative recommendations, the left/right logic may be reversed for one or more dimensions.)</i>	
Rationale for judgment and selection of each dimension:	
1. Grade of the Body of Evidence	<input type="checkbox"/> High <input checked="" type="checkbox"/> Moderate <input type="checkbox"/> Low
2. Safety/Harm (Side Effects and Risks)	<input checked="" type="checkbox"/> Minimal <input type="checkbox"/> Moderate <input type="checkbox"/> Serious
<i>Rationale: There is minimal harm in an appropriately trained physical therapist clinician monitoring vital signs of overweight and obese children and adolescents during a treatment session.</i>	
3. Health benefit to patient	<input type="checkbox"/> Significant <input checked="" type="checkbox"/> Moderate <input type="checkbox"/> Minimal
<i>Rationale: Based on the synthesis of the aforementioned studies, monitoring vital signs during a physical therapy treatment session to ensure children and adolescents are below the lactate threshold, are within target heart rate, and are within safe ranges of systolic and diastolic blood pressure may allow greater tolerance to exercise. With monitoring vital signs, the therapist will be able to track if certain exercises are increasing vital signs too rapidly and in turn, decrease the ability of the patient to perform the exercise. With the therapist monitoring the vital signs and subjective RPE, the therapist can ensure that the patient's physiological and psychological response is within an appropriate range for the goal of the treatment session.</i>	
4. Burden on patient to adhere to recommendation	<input checked="" type="checkbox"/> Low <input type="checkbox"/> Unable to determine <input type="checkbox"/> High
<i>Rationale: No burden on patient to adhere to recommendation</i>	
5. Cost-effectiveness to healthcare system	<input type="checkbox"/> Cost-effective <input checked="" type="checkbox"/> Inconclusive <input type="checkbox"/> Not cost-effective
<i>Rationale:</i>	
6. Directness of the evidence for this target population	<input type="checkbox"/> Directly relates <input checked="" type="checkbox"/> Some concern of directness <input type="checkbox"/> Indirectly relates
<i>Rationale: The literature focuses on physical activity in general and not specifically to the physical therapy clinic. However, in the outpatient physical therapy setting, exercise is typically the main treatment intervention.</i>	
7. Impact on morbidity/mortality or quality of life	<input type="checkbox"/> High <input checked="" type="checkbox"/> Medium <input type="checkbox"/> Low
<i>Rationale: It is assumed that improved tolerance and adherence to exercise during physical therapy sessions will improve musculoskeletal and cardiovascular outcomes. Participation in moderate to vigorous physical activity can lower blood pressure, decrease BMI, and decrease risk of vascular dysfunction (Gaya [4a]; Torrance [5b])</i>	

Copies of this Best Evidence Statement (BEST) and related tools (if applicable, e.g., screening tools, algorithms, etc.) are available online and may be distributed by any organization for the global purpose of improving child health outcomes.

Website address: <http://www.cincinnatichildrens.org/service/i/anderson-center/evidence-based-care/bests/>

Examples of approved uses of the BEST include the following:

- Copies may be provided to anyone involved in the organization's process for developing and implementing evidence based care;
- Hyperlinks to the CCHMC website may be placed on the organization's website;
- The BEST may be adopted or adapted for use within the organization, provided that CCHMC receives appropriate attribution on all written or electronic documents; and
- Copies may be provided to patients and the clinicians who manage their care.

Notification of CCHMC at EBDMinfo@cchmc.org for any BEST adopted, adapted, implemented, or hyperlinked by the organization is appreciated.

Please cite as: Boyd, A., Paterno, M., Cincinnati Children's Hospital Medical Center: Best Evidence Statement Vital Sign Monitoring in Children and Adolescents who are Overweight or Obese in the Outpatient Physical Therapy Clinic, <http://www.cincinnatichildrens.org/svc/alpha/h/health-policy/best.htm>, BEST 155, pages 1-6, 2/19/13.

This Best Evidence Statement has been reviewed against quality criteria by two independent reviewers from the CCHMC Evidence Collaboration. Conflict of interest declaration forms are filed with the CCHMC EBDM group.

Once the BEST has been in place for five years, the development team reconvenes to explore the continued validity of the guideline. This phase can be initiated at any point that evidence indicates a critical change is needed. CCHMC EBDM staff perform a quarterly search for new evidence in an horizon scanning process. If new evidence arises related to this BEST, authors are contacted to evaluate and revise, if necessary.

For more information about CCHMC Best Evidence Statements and the development process, contact the Evidence Collaboration at EBDMinfo@cchmc.org.

Note

This Best Evidence Statement addresses only key points of care for the target population; it is not intended to be a comprehensive practice guideline. These recommendations result from review of literature and practices current at the time of their formulation. This Best Evidence Statement does not preclude using care modalities proven efficacious in studies published subsequent to the current revision of this document. This document is not intended to impose standards of care preventing selective variances from the recommendations to meet the specific and unique requirements of individual patients. Adherence to this Statement is voluntary. The clinician in light of the individual circumstances presented by the patient must make the ultimate judgment regarding the priority of any specific procedure.