



## HEALTH BENEFITS TO CHILDREN FROM CONTACT WITH THE OUTDOORS & NATURE

NOTE: The following are taken from four volumes of research developed by the Children & Nature Network (C&NN) and available at [www.childrenandnature.org](http://www.childrenandnature.org). These C&NN Annotated Bibliographies of Research and Studies were written by Cheryl Charles, Ph.D., President, Children & Nature Network and Alicia Senauer, Yale University.

### ***Focus: Literature Reviews & Overview Documents***

These articles summarize literature related to outdoor and nature contact and children's health and well-being.

### **Greenspace supports children's quality of life**

Bell and colleagues critically review the last 10 years of research that has examined relationships between greenspace and quality of life. Major areas reviewed in this report are: health and well-being, social and community value, economic value/impacts, environmental value, and planning and design. Research related to children is one of the main topics highlighted in the various sections of this report. In their review, Bell and colleagues also discuss their criteria for article inclusion, highlight methodological limitations of studies conducted to date, and identify key research gaps.

Author Affiliation: The authors are with the OPENspace research center in the UK.

**Bell, S., Hamilton, V., Montarzino, A., Rothnie, H., Travlou, P., & Alves, S. (2008). Greenspace and quality of life: a critical literature review. Greenspace Scotland.** This report is available online at: <http://www.greenspacescotland.org.uk/default.asp?page=465> (Volume 4)

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### **Time spent outdoors supports many aspects of children's health**

In this report, Muñoz reviews literature concerning the linkage between spending time outdoors and health, with a primary emphasis on research related to children. She reviews research and policy related to outdoor use and health more generally and then takes an in-depth look at topics related to children's use of the outdoors and relationships to their health. Specific topics Muñoz examines include research linking children's time spent outdoors to increased physical activity, healthy development, and overall well-being. She also examines research related to the design of children's

play spaces, access to natural spaces, the use of outdoors in children's education, and research related to people and factors that constrain and enable children's outdoor play. Finally, in concluding her literature review, Muñoz identifies methodological considerations, research gaps, and provides suggestions for advancing knowledge in this area.

Author Affiliation: Muñoz is with the Sustainable Development Research Centre in Scotland.

**Muñoz, S. A. (2009). Children in the outdoors: a literature review. Sustainable Development Research Centre.** This report is available online at: <http://www.countrysiderecreation.org.uk/Children%20Outdoors.pdf> (Volume 4)

Readers may also be interested in the following related report:

**Scottish Natural Heritage. (2009). Health and the natural heritage-the evidence base. Retrieved September 7, 2009, from <http://www.snh.org.uk/pdfs/strategy/Healthevidence.pdf>**

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### **Contact with nature provides a variety of health benefits**

In this report, C. Maller and colleagues reviewed published literature demonstrating health and well-being benefits from contact with nature, with an emphasis on park settings. Particularly in urban areas, parks play an important role in providing people with access to nature. The authors encourage a reframing of our traditional view of parks as places for leisure and sport towards one that emphasizes a full range of physical, mental, and social health benefits. Maller and colleagues provide valuable background material on the concept of health and the connection between nature and health. The authors then review evidence of the health benefits of various forms of contact with nature, including viewing nature, being in nature, contact with plants, and contact with animals. Maller and colleagues provide a number of recommendations, including the need for additional research, the repositioning of parks, and the integration of parks and nature into public health strategies and management actions. The authors present a number of useful summary tables, which provide quick access to major findings about the health benefits of contact with nature.

**Maller, C., Townsend, M., St.Leger, L., Henderson-Wilson, C., Pryor, A., Prosser, L., and Moore, M. (2008). "The health benefits of contact with nature in a park context: A review of relevant literature." Deakin University and Parks Victoria.** The original 2002 review and annotated bibliography are available online at: [http://www.parkweb.vic.gov.au/1process\\_content.cfm?section=99&page=16](http://www.parkweb.vic.gov.au/1process_content.cfm?section=99&page=16). The updated 2008 review is available for a nominal fee by contacting Mardie Townsend at [mardie.townsend@deakin.edu](mailto:mardie.townsend@deakin.edu) (Volume 3)

Readers may also be interested in the following documents:

A fact sheet on the health benefits of the natural environment by the National Environmental Education Foundation.

This fact sheet is available online at: <http://www.neefusa.org/assets/files/NIFactSheet.pdf>

An article by Howard Frumkin and Richard Louv about the important role natural landscapes play in protecting public health. This article is available online at: <http://atfiles.org/files/pdf/FrumkinLouv.pdf>

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### **Children's play in natural settings provides a suite of benefits**

In this report, Stuart Lester and Martin Maudsley provide an extensive review of the literature related to children's natural play. The authors begin by examining the human relationship with the natural world and the importance of play and direct interaction with the physical environment to children. Lester and Maudsley then review the important opportunities that natural play provides, such as the creation of special places, and the numerous documented and potential benefits of children's play in natural settings, including the development of a sense of self and independence.

The authors discuss evidence demonstrating a decline in children’s access and opportunities to play in natural spaces and provide a range of suggestions to support children’s opportunities to play in natural settings, such as through the design of effective playgrounds, school grounds, and environmental play projects, as well as ensuring adequate access to parks and nature reserves.

Lester, S., & Maudsley, M. (2006). “*Play, naturally: A review of children's natural play.*” Children's Play Council. This report is available online at: <http://www.playday.org.uk/PDF/play-naturally-a-review-of-childrens-natural%20play.pdf> (Volume 3)

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### **The importance of designing spaces that support children’s contact with nature**

In this book chapter, Robin Moore and Clare Cooper Marcus review health threats that face many of today’s children, including sedentary behavior and attention deficit disorder; the benefits that contact with nature provides to children’s mental, social, and physical health; and current barriers limiting children’s access to nature. The authors provide examples of designed environments, specifically in urban areas, that support children’s contact with nature, including examples of innovative childcare centers and preschools, school grounds, neighborhood parks, and community institutions. Moore and Marcus emphasize the importance of the residential environment and the need to understand and incorporate children’s ideas and preferences into the planning and design of spaces. The authors discuss four models of child-friendly residential neighborhood layouts with specific national and international case studies, including clustered housing and shared outdoor space, cul-de-sacs and greenways, alleys, and home zones. Moore and Marcus conclude by providing a number of key recommendations to help ensure children’s access to nature in residential environments.

Moore, R. C., & Cooper Marcus, C. (2008). “Healthy planet, healthy children: Designing nature into the daily spaces of childhood.” In S. Kellert, J. Heerwagen & M. Mador (Eds.), *Biophilic design: Theory, science and practice*. Hoboken, NJ: John Wiley & Sons, Inc. This book chapter is available online at: [http://www.naturalearning.org/docs/MooreCooperMarcus\\_Healthy.pdf](http://www.naturalearning.org/docs/MooreCooperMarcus_Healthy.pdf) (Volume 3)

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### **Direct experience in nature is critical and diminishing**

Nature is important to children’s development in every major way — intellectually, emotionally, socially, spiritually, and physically. In one of his newest books, *Building for Life: Designing and Understanding the Human-Nature Connection* (Island Press, 2005), Dr. Stephen R. Kellert of Yale University devotes a chapter to the subject of “Nature and Childhood Development.” Combining his original research with well-documented references to the research of others, this chapter is a powerful synthesis of what we know, and what we do not know, about the importance of nature to children’s healthy development. Kellert states, “Play in nature, particularly during the critical period of middle childhood, appears to be an especially important time for developing the capacities for creativity, problem-solving, and emotional and intellectual development.” He includes research to indicate optimal learning opportunities at age-appropriate times and differentiates between indirect, vicarious, and direct experiences with nature — with the latter less and less available to children. He urges designers, developers, educators, political leaders and citizens throughout society to make changes in our modern built environments to provide children with positive contact with nature — where children live, play, and learn. (Original Research and Synthesis)

Kellert, Stephen R. “Nature and Childhood Development.” In *Building for Life: Designing and Understanding the Human-Nature Connection*. Washington, D.C.: Island Press, 2005. Full book available via Amazon.com

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and other commercial sources. [http://www.cnaturenet.org/02\\_rsrch\\_studies/PDFs/Kellert\\_BuildingforLife.pdf](http://www.cnaturenet.org/02_rsrch_studies/PDFs/Kellert_BuildingforLife.pdf) (Chapter 3). (Volume 1)

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### **Unstructured free play brings cognitive, social and health benefits to children**

Unstructured free play in the out-of-doors brings a host of benefits to children —from being smarter to more cooperative to healthier overall. This well-documented article by two physicians builds a strong case for the importance of unstructured free play in the out-of-doors for all age groups, and especially young children. While concerned about the “obesity epidemic” in young children, the authors say that the health benefits from outdoor play are only one aspect of the overall benefits. They suggest that the concept of “play” is more compelling and inviting to most adult caregivers, parents and guardians than “exercise.” The authors cite cognitive benefits from play in nature, including creativity, problem-solving, focus and self-discipline. Social benefits include cooperation, flexibility, and self-awareness. Emotional benefits include stress reduction, reduced aggression and increased happiness. Children will be smarter, better able to get along with others, healthier and happier when they have regular opportunities for free and unstructured play in the out-of-doors. (Synthesis)

**Burdette, Hillary L., M.D., M.S.; and Robert C. Whitaker, M.D, M.P.H. “Resurrecting Free Play in Young Children: Looking Beyond Fitness and Fatness to Attention, Affiliation and Affect.” © 2005 American Medical Association. [http://www.cnaturenet.org/02\\_rsrch\\_studies/PDFs/Burdette\\_LookingBeyond.pdf](http://www.cnaturenet.org/02_rsrch_studies/PDFs/Burdette_LookingBeyond.pdf) (Volume 1)**

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### **Contact with nature is important for children**

Andrea Faber Taylor and Frances E. Kuo have contributed important research to the understanding of the impact of nature on people’s lives, and specifically to the well-being of children. This particular article is a recent review of the literature and establishes what is known, and what is still missing, about the effects of contact with nature on children’s lives. While the evidence is growing, this article is an important call to action for further research.

**Taylor, Andrea Faber; and Frances E. Kuo. “Is Contact with Nature Important for Healthy Child Development? State of the Evidence.” In Spencer, C. & Blades, M. (Eds.), *Children and Their Environments: Learning, Using and Designing Spaces*. Cambridge, UK: Cambridge University Press, 2006. <http://www.lhhl.uiuc.edu/documents/Faber2006Iscontactwithnature.pdf> (Volume 1)**

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### **City parks bring social, community health and economic benefits**

The Trust for Public Land (TPL) is a premier conservation organization, responsible for protection of special public lands throughout several generations. Today TPL is concerned not just about setting lands aside for future generations, but making sure that young people and families enjoy them today. TPL recognizes that to connect with nature is to appreciate nature, now and for the long term. This comprehensive report, “The Benefits of Parks: Why America Needs More City Parks and Open Space,” offers a clear look at socioeconomic factors affecting the availability of parks, the history of city parks, and the hopes for a revival of commitment to city parks. The report outlines benefits in a number of areas: physical, including remedies for inactivity and obesity; economic, with increased property values; environmental, with pollution abatement; and social, from crime reduction to strengthening communities. Add this report to your collection of those that serve to document how safe places for children to play contribute to everyone’s health and well being. (Synthesis)

[http://www.tpl.org/content\\_documents/parks\\_for\\_people\\_Jul2005.pdf](http://www.tpl.org/content_documents/parks_for_people_Jul2005.pdf) (Volume 1)

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### ***Focus: Mental Health***

These articles examine relationships between children's contact with the outdoors and/or nature and their psychological and cognitive performance and functioning.

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#### **Children with ADHD concentrate better after walking in a park**

Building off of their recent work related to children with Attention-deficit hyperactivity disorder (ADHD) and different types of activity settings, in this study, Andrea Faber Taylor and Frances Kuo investigate the impacts of three different outdoor environments on the attention of seventeen 7- to 12-year-old children diagnosed with ADHD. After completing a series of puzzles that required focused attention, each child, over the course of three different weeks, participated in a 20 minute guided walk in three different outdoor settings (an urban park, a downtown area, and a residential area). After each guided walk, children completed a concentration test and answered several questions about their walking experience. Importantly, the authors controlled for a number of potential confounding factors, including the order of environments experienced, the time of day and day of week, terrain, and season. In analyzing the data, Faber Taylor and Kuo found that children concentrated better after walking in a park setting as compared to either a downtown or residential setting and that the effect of walking in a park on concentration helped close the gap between children with ADHD and those without ADHD with regard to the concentration measure used and that the effect was similar to that of two common types of ADHD medication. In addition, the authors found that children rated their experiences more positively in the park setting than in the other two settings. Faber Taylor and Kuo discuss these findings in light of Attention Restoration Theory and their previous studies related to different environments and children with ADHD and suggest additional avenues for research and the potential of using nature in the treatment of ADHD.

**Faber Taylor, A., & Kuo, F. E. (2008). Children with attention deficits concentrate better after walk in the park. *Journal of Attention Disorders OnlineFirst*.** This article will be published in print in 2009 and may be available in a library near you or can be purchased online at: <http://jad.sagepub.com>. (Volume 3)

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#### **Natural settings provide psychological benefits**

“Coping with ADD: The Surprising Connection to Green Play Settings,” by Andrea Faber Taylor; Frances E. Kuo; and William C. Sullivan (2001) is one of the earliest studies to explore the potential for contact with nature to have a positive effect in reducing the impact of attention deficit disorder in children. The study was designed to test two hypotheses: 1) Attention deficit symptoms will be more manageable after activities in green settings than after activities in other settings; and 2) The greener a child's everyday environment, the more manageable their attention deficit symptoms will be in general. The results were positive. (Original Research)

**Taylor, Andrea Faber; Frances E. Kuo; and William C. Sullivan. In *Environment and Behavior*, Vol. 33, No. 1, January 2001. © 2001 Sage Publications, Inc. Available on the web site of the University of Illinois Urbana-Champaign. <http://www.lhhl.uiuc.edu/> (Volume 1)**

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#### **Nature activities soothe ADD symptoms**

Contact with the natural world can significantly reduce symptoms of attention deficit disorder in children as young as five. Here is another important study that supports this finding. In addition to access to reports of the primary research, the scholars provide a Power Point presentation that may

be used in communities to disseminate this positive information based on sound research. (Original Research)

Kuo, Frances E.; and Andrea Faber Taylor. "A Potential Natural Treatment for Attention-Deficit/Hyperactivity Disorder: Evidence from a National Study." In *American Journal of Public Health*, Vol 94, No. 9, September 2004. © American Public Health Association. The study and the educational Power Point are available on the web site of the University of Illinois Urbana-Champaign. <http://www.lhhl.uiuc.edu/> (Volume 1)

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### **Nearby nature reduces stress in children**

This study, reported in 2003, by Cornell assistant professor Nancy Wells, focuses on rural children and finds that even a view of nature — green plants and vistas — helps reduce stress among highly stressed children. Further, the more plants, green views and access to natural play areas, the more positive the results. (Original Research)

Wells, N.M., and Evans, G.W. "Nearby Nature: A Buffer of Life Stress Among Rural Children." *Environment and Behavior*. Vol. 35:3, 311-330. This study is not available online without purchase; <http://www.sagepub.co.uk/journals/details/j0163.html> (Volume 1)

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### **Nearby nature boosts children's cognitive functioning**

A precursor to Nancy Wells' study reported above, this research, reported in 2000, shows that proximity to, views of, and daily exposure to natural settings increases children's ability to focus and therefore enhances cognitive abilities. (Original Research)

Wells, N.M. "At Home with Nature: Effects of 'Greenness' on Children's Cognitive Functioning." *Environment and Behavior*. Vol. 32, No. 6, 775-795. This study is not available online without purchase; <http://eab.sagepub.com/cgi/content/abstract/32/6/775> (Volume 1)

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### ***Focus: Physical Health***

These articles examine linkages between the design of children's environments, children's outdoor-related behavior and their physical health, including physical activity, development, and functioning.

### **Older children who spend more time outside tend to be more physically active and are less likely to be overweight**

Cleland and colleagues investigated whether the amount of time children spend outdoors is related to their physical activity levels and being overweight. About 200 five- to six-year-old and 350 ten- to twelve-year-old children from 19 randomly selected elementary schools in Melbourne, Australia participated in this study. In 2001 and 2004, parents reported the amount of time their children spent outdoors and researchers recorded children's physical activity levels using an accelerometer and measured children's weight and height. In their paper, Cleland and colleagues report many findings, some of which are discussed below. The researchers found, for example, that children spent significantly more time outdoors during warmer months as compared to cooler months; boys had significantly higher levels of moderate and vigorous physical activity (MVPA) on weekdays than

girls; the prevalence of overweight increased significantly between 2001 and 2004 for both younger and older children, as well as boys and girls; and among the older children, boys generally spent significantly more time outside than girls. Cleland and colleagues also found that older children who spent more time outside were generally more physically active and had a lower prevalence of overweight than children who spent less time outside. For example, the researchers found that each additional hour older girls spent outside during the cooler months was associated with an extra 26.5 minutes per week of MVPA and that each additional hour older boys spent outside during the cooler months was associated with an extra 21 minutes of MVPA. When examining changes over the three-year period, Cleland and colleagues found that the more time older girls and boys spent outside on weekends at baseline (2001), the higher their MVPA on weekends at follow-up (2004). In addition, the researchers found that in 2004, the prevalence of overweight among older children was 27-41% lower for those children who spent more time outside in 2001. With regard to younger children, Cleland and colleagues found few associations between time spent outdoors, physical activity, and overweight. While this study may be limited due to its reliance on parental self-report of children's time spent outside, the cross-sectional and longitudinal nature of this study and objective measurement of physical activity provide an important contribution to the literature. The results of this study suggest that encouraging 10- to 12-year-old children to spend more time outdoors may help increase physical activity levels and reduce the prevalence of overweight.

Author Affiliation: Cleland, Crawford, Hume, Timperio, and Salmon are with Deakin University in Australia. Baur is with the University of Sydney in Australia.

**Cleland, V., Crawford, D., Baur, L. A., Hume, C., Timperio, A., & Salmon, J. (2008). A prospective examination of children's time spent outdoors, objectively measured physical activity and overweight. *International Journal of Obesity, 32*(11), 1685-1693.** This study may be available in a library near you or can be purchased online through the publisher at: <http://www.nature.com/ijo/index.htm> (Volume 4)

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### **Green school grounds improve quantity and quality of elementary school children's physical activity**

In recent years, there has been increasing interest in greening school grounds to diversify children's play experiences, such as through the planting of trees, building of ponds, and development of vegetable gardens. Dymont and Bell investigated how green school grounds affect the physical activity of elementary school children by sending questionnaires to a diversity of Canadian schools that had greened their school grounds. Questionnaires were completed by 105 individuals from 59 schools who had been involved in their school's greening project. In analyzing the study data, Dymont and Bell found that green areas were an important place for physical activity: respondents reported that 66% of students use green areas for active play. Interestingly, the researchers found that green areas tended to support more moderate and light activity as opposed to the more vigorous activity that generally takes place in traditional turf and asphalt areas. Dymont and Bell found that nearly 50% of the respondents reported that their school ground promotes more vigorous activity after greening, while about 70% reported more moderate and/or light physical activity taking place after greening. In addition, the researchers found that 90% of respondents reported that their school ground appeals to a wider variety of student interests after greening; 85% reported that their school ground now supports a wider variety of play activities; and 84% reported that since greening, their school ground encourages more exploration of the natural world. While this study may be limited due to its reliance on retrospective self-report, it provides important insight into the benefits of green school grounds and their potentially significant role in

complementing more traditional school ground areas and improving the quality and quality of elementary school children's physical activity.

Author Affiliation: Dymont is with the University of Tasmania in Australia. Bell is with Evergreen in Canada.

**Dymont, J. E., & Bell, A. C. (2008). Grounds for movement: green school grounds as sites for promoting physical activity. *Health Education Research*, 23(6), 952-962.** This study may be available in a library near you or can be purchased online through the publisher at: <http://her.oxfordjournals.org/> (Volume 4)

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### **Schoolyard size and landscape quality influence children's satisfaction and weight**

Outdoor school grounds are an important environment to consider when striving to promote children's physical activity and reduce childhood obesity. In this study, Ozdemir and Yilmaz investigate linkages between the physical characteristics of children's schoolyard environments and their attitudes, physical activity, and body mass index (BMI). The researchers interviewed nearly 300 3<sup>rd</sup> and 4<sup>th</sup> grade students, as well as teachers, and administrators in five public schools in Ankara, Turkey. Ozdemir and Yilmaz also measured students' weight and height, and had professionals assess the schoolyard environment based on factors such as size, material, vegetation cover, and maintenance. Although schoolyards differed, the researchers found that students generally had no direct contact with vegetation and that the amount of outdoor space was limited given the number of students using the space. While most students were satisfied with their schoolyard, which the researchers speculate may be due to acclimation, unsatisfied students highlighted the lack of trees and greenery as the primary reason for their dissatisfaction. Among their many findings, Ozdemir and Yilmaz report that the size of the schoolyard was significantly related to students' BMI, with students in larger yards having lower BMI values than students in smaller yards. The researchers also found that yard landscape characteristics were significantly associated with children's BMI values, but in the opposite direction than expected: students from schools with "advanced" landscape features had higher BMI values than students from schools with "low" landscape features, although BMI values were still in the normal range. While this study may be limited due to its relatively small sample size and reliance on self-report measures, it highlights the importance of participatory and well-thought-out school landscape design, as well as the need for adequate financing and maintenance of schoolyards.

Author Affiliation: The authors are with Ankara University in Turkey.

**Ozdemir, A., & Yilmaz, O. (2008). Assessment of outdoor school environments and physical activity in Ankara's primary schools. *Journal of Environmental Psychology*, 28(3), 287-300.** This study may be available in a library near you or can be purchased online through the publisher at: [http://www.elsevier.com/wps/find/journaldescription.cws\\_home/622872/description#description](http://www.elsevier.com/wps/find/journaldescription.cws_home/622872/description#description) (Volume 4)

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### **Children in greener neighborhoods have lower body weight changes**

Bell and colleagues examined the medical records of 4,000 three- to sixteen-year-old children that lived in Marion County, Indiana, received care from a particular clinic network between 1996 and 2002, had height and weight measurements for two consecutive years, and lived at the same residential address for at least two years. The majority of participants in this study were non-Hispanic black and enrolled in Medicaid (an indicator of socioeconomic status). Bell and colleagues geocoded each participant's address using a Geographic Information System and measured greenness at these locations using satellite images and a vegetation index. The researchers speculated



that neighborhood greenness might serve as an indicator of children's access to spaces that promote physical activity or increased time outside. In analyzing the study data, Bell and colleagues found that the amount of vegetation in a child's neighborhood was inversely correlated with their Body Mass Index (BMI) score at the year two measurement. That is, in general, the more vegetation a child had in their neighborhood, the lower their body weight changes. The researchers also found that children in more vegetated settings were less likely to have a higher BMI over 2 years as compared to children in less vegetated settings. Importantly, Bell and colleagues controlled for a number of other factors in their analyses, such as residential density. While the study is observational and thus cannot causally link neighborhood greenness and body weight changes, this research highlights the role that neighborhood vegetation could play in policies and programs aimed at preventing childhood obesity.

Author Affiliation: Bell is with the University of Washington. Wilson is with Indiana University-Purdue University. Liu is with Indiana University.

**Bell, J. F., Wilson, J. S., & Liu, G. C. (2008). Neighborhood greenness and 2-year changes in Body Mass Index of children and youth. *American Journal of Preventive Medicine*, 35(6), 547-553.** This study may be available in a library near you or can be purchased online through the publisher at: <http://www.ajpm-online.net/> (Volume 4)

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### **Community design can promote and support children's physical activity**

This article is a policy statement by the American Academy of Pediatrics' Committee on Environmental Health regarding the influence that community design has on children's opportunities to be physically active. The Committee highlights the role of neighborhood design in promoting recreational and incidental or "utilitarian" physical activity, such as the availability of parks and recreational facilities, as well as children's ability to walk to school. The Committee also highlights important factors influencing children's physical activity, including traffic danger, the presence of sidewalks, and perception and fear of crime. Finally, the Committee provides a number of specific recommendations for pediatricians and government to promote children's physical activity in the built environment and support more active lifestyles.

**Binns, H. J., Forman, J. A., Karr, C. J., Osterhoudt, K., Paulson, J. A., Roberts, J. R., et al. (2009). The built environment: designing communities to promote physical activity in children. *Pediatrics*, 123(6), 1591-1598.** This study may be available in a library near you or can be purchased online through the publisher at: <http://www.jpeds.com/> (Volume 4)

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### **Children with a park playground near their home are more likely to be of a healthy weight**

Physical activity is thought to play an important role in childhood obesity. While research results to date are somewhat mixed, parks can provide important opportunities for children to be physically active. In this study, Potwarka and colleagues examine whether children's weight is related to park space and the availability of specific park facilities within 1km of children's homes. Researchers collected information on 108 two- to seventeen-year-old children from four neighborhoods in a mid-sized city in Ontario, Canada. Parents reported their child's height and weight, while researchers used a Geographic Information System to assess park space for each child and a database and trained observers to assess park facilities. In analyzing the study data, Potwarka and colleagues found that proximity to park space was not significantly related to children's weight status. The researchers did find, however, that when examining park facilities, children with a park playground within 1 km of their homes were five times more likely to be of a healthy weight than children without a park

playground near their homes. While this study may be limited due to its relatively small sample size, reliance on parental report, and focus on availability as opposed to actual use of park space, this study provides valuable insight into the potential importance of children's proximity to specific park facilities as opposed to park space in general.

Author Affiliation: The authors are with the University of Waterloo in Canada.

**Potwarka, L. R., Kaczynski, A. T., & Flack, A. L. (2008). Places to play: association of park space and facilities with healthy weight status among children. *Journal of Community Health, 33*(5), 344-350.** This study may be available in a library near you or can be purchased online through the publisher at: <http://www.springer.com/public+health/health+promotion+&+disease+prevention/journal/10900> (Volume 4)

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### **Public open space features may influence children's physical activity**

Public open spaces may be important places for children to play and be physically active. Timperio and colleagues investigated relationships between the specific features of public open spaces and children's physical activity by examining data collected as part of a neighborhood study in Melbourne, Australia. Participants in this study included 163 eight- to nine-year-old children and 334 thirteen- to fifteen-year-old children. Participants wore an accelerometer for one week to measure their physical activity and researchers used a Geographic Information System and trained observer to identify and analyze the closest public open space to each child's home. In analyzing the data, Timperio and colleagues found that younger children spent significantly more time engaged in moderate to vigorous physical activity (MVPA) on weekdays and weekends as compared to adolescents. While there were no gender differences among younger children, among adolescents researchers found that boys spent significantly more time engaged in MVPA on weekdays and weekends as compared to girls. With regard to public open space, Timperio and colleagues found that participants, on average, lived about 300 meters from their closest public open space. When examining relationships between features of children's closest public open space and physical activity, researchers obtained somewhat mixed and inconsistent results. For example, researchers found that playgrounds were positively associated with younger boys' weekend physical activity, the number of recreational facilities was inversely associated with younger girls' physical activity after school and on the weekend, and the presence of trees and signage regarding dogs were positively associated with adolescent girls' physical activity after school. While this study provides one of the few examinations of public open space features and children's physical activity, additional research is needed to better understand children's actual use of public open space and the quantity and quality of public open space features.

Author Affiliation: Timperio, Crawford, Andrianopoulos, Ball, Salmon, and Hume are with Deakin University in Australia. Giles-Corti is with the University of Western Australia.

**Timperio, A., Giles-Corti, B., Crawford, D., Andrianopoulos, N., Ball, K., Salmon, J., et al. (2008). Features of public open spaces and physical activity among children: findings from the CLAN study. *Preventive Medicine, 47*(5), 514-518.** This study may be available in a library near you or can be purchased online through the publisher at: [www.elsevier.com/locate/amepre](http://www.elsevier.com/locate/amepre) (Volume 4)

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### **Neighborhood recreation facilities positively influence children's physical activity levels**

Tucker and colleagues examined children's physical activity levels in relation to several neighborhood environmental factors and parents' perceptions of recreation opportunities. Over 800

eleven- to thirteen-year-old children in London, Ontario completed a questionnaire regarding their physical activity levels on the preceding day. In addition, parents completed a questionnaire evaluating their child's home environment and researchers used a Geographic Information System to analyze each child's neighborhood environment. In analyzing the data, Tucker and colleagues found that, on average, children engaged in about 160 minutes of physical activity a day. In addition, researchers found that neighborhood recreational opportunities significantly and positively influenced children's physical activity levels. For example, Tucker and colleagues found that children with two or more recreation facilities in their neighborhood engaged in almost 17 more minutes of physical activity after school as compared to children with less than 2 recreation facilities and were almost 2 times as likely to be in the upper quartile for after school physical activity. Importantly, researchers controlled for a number of other factors in their analyses, including season and demographic factors. Tucker and colleagues also found that land use mix and percentage of park coverage did not significantly influence children's physical activity levels. While this study is cross-sectional in nature, relied on self-report, and focused on quantity and not quality of recreation facilities, it provides valuable insight into how neighborhood recreation opportunities may influence children's physical activity levels.

Author Affiliation: Tucker, Irwin, Gilliland, and Larsen are with the University of Western Ontario in Canada. He is with Brescia University College and Middlesex London Health Unit. Hess is with the University of Toronto in Canada.

**Tucker, P., Irwin, J. D., Gilliland, J., He, M., Larsen, K., & Hess, P. (2009). Environmental influences on physical activity levels in youth. *Health & Place, 15*(1), 357-363.** This study may be available in a library near you or can be purchased online through the publisher at: [http://www.elsevier.com/wps/find/journaldescription.cws\\_home/30519/description#description](http://www.elsevier.com/wps/find/journaldescription.cws_home/30519/description#description) (Volume 4)

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### **Adolescents' local environments influence their physical activity and food consumption**

Eating well and being physically active are important to good health and well-being. In this article, Tucker and colleagues review the impact of home, school, and neighborhood environments on adolescents' food behavior and physical activity, and investigate adolescents' perceptions of these environments. As part of this study, researchers interviewed 60 twelve- to fourteen-year-old adolescents in focus groups in London, Ontario, Canada. Tucker and colleagues analyzed the content of information discussed in each focus group to understand influences on participants' food consumption and physical activity. Researchers found that schools, nearby parks, and recreation facilities, as well as other structural opportunities around homes (e.g., yards and other kids) influenced adolescents' physical activity and served as both a facilitator and barrier to their physical activity. For example, the majority of adolescents reported using parks often, however, some participants commented on the small size of local parks, amount of garbage, and the lack of opportunities for older children. Tucker and colleagues also found that adolescents identified the availability of fast-food restaurants, convenience stores, and other restaurants as impacting their food consumption and that a number of participants identified the lack of healthy foods in their schools and neighborhoods. While this study may be limited due to its small sample size and reliance on volunteers, it offers important insight into the local environment's influence on adolescents' physical activity and food consumption.

Author Affiliation: Tucker is with the Middlesex-London Health Unit in Canada. Irwin and Gilliland are with the University of Western Ontario in Canada. He is with the University of Texas at San Antonio.

Tucker, P., Irwin, J. D., Gilliland, J., & He, M. (2008). Adolescents' perspectives of home, school and neighborhood environmental influences on physical activity and dietary behaviors. *Children, Youth and Environments, 18*(2), 12-35. This article is available online at: [http://www.colorado.edu/journals/cye/index\\_issues.htm](http://www.colorado.edu/journals/cye/index_issues.htm). (Volume 4)

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### **Spending time outdoors, among other factors, is associated with higher levels of physical activity in preschool children**

Physical activity provides important health benefits to children. Unfortunately, not much is known about the prevalence of preschool children's physical activity levels and the factors that most influence physical activity in this age group. In this paper, T. Hinkley and colleagues review 24 studies published between 1980 and 2007 that investigated factors related to physical activity levels in preschool children. The authors examined a total of 39 different variables, such as gender and time spent outdoors, and coded the results to identify consistency/inconsistency across studies. In the end, Hinkley and colleagues found support for the following findings: 1) boys are more active than girls, 2) a child's age and body mass index are not related to physical activity, 3) children who have parents that participate in physical activity with them are more active than children who have parents that do not participate with them in physical activity, and 4) children who spend more time outdoors are more active than children who spend less time outdoors. The authors also found that psychological, cognitive, emotional, and behavioral variables have not been studied enough to yield conclusive results with regard to their association to physical activity levels in preschool children. Hinkley and colleagues review the strengths and weaknesses of studies to date, compare their results to those found for older children and adolescents, and highlight future research needs in order to better understand the many factors that influence preschool children's physical activity.

Hinkley, T., Crawford, D., Salmon, J., Okely, A. D., & Hesketh, K. (2008). "Preschool children and physical activity - A review of correlates." *American Journal of Preventive Medicine, 34*(5), 435-441. This study may be available in a library near you or can be purchased online through the publisher at: <http://www.elsevier.com> (Volume 3)

Readers may also be interested in a 2000 review by Sallis and colleagues that summarizes research on correlates of physical activity behaviors in children and adolescents.

Sallis, J. F., Prochaska, J. J., & Taylor, W. C. (2000). "A review of correlates of physical activity of children and adolescents." *Medicine and Science in Sports and Exercise, 32*(5), 963-975. This study may be available in a library near you or can be purchased online through the publisher at: <http://www.ms-se.com/>

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### **Neighborhood parks play an important role in promoting physical activity in children**

Although the American Academy of Pediatrics has recommended that children be physically active for at least 60 minutes a day and limit sedentary activity to less than 2 hours a day, many children do not meet these recommendations. In this article, Victoria Floriani and Christine Kennedy review the latest research findings with regard to the promotion of physical activity in children. For example, the authors discuss a number of studies which have found that access to a neighborhood park or playground is associated with higher levels of physical activity in children and that specific park amenities, such as lighting after dark, may be important in facilitating park use. Floriani and Kennedy also summarize research on sedentary behavior and how evidence, while often inconclusive, indicates that the less time children spend in sedentary behaviors, the more physically active they may be. In addition, the authors highlight recent research exploring the relationship

between mental health and physical activity. While there is still much to be learned about this relationship, preliminary research has found a positive relationship between higher levels of physical activity and positive mental health outcomes, such as increased feelings of self-efficacy and confidence. Floriani and Kennedy conclude the article by encouraging pediatric health care providers to discuss physical activity with their patients and strategize with them on ways to incorporate activity into their daily lives.

Floriani, V., & Kennedy, C. (2008). "Promotion of physical activity in children." *Current Opinion in Pediatrics*, 20(1), 90-95. This article is available online at: [http://www.parks.sfgov.org/wcm\\_recpark/SPTF/Floriani.pdf](http://www.parks.sfgov.org/wcm_recpark/SPTF/Floriani.pdf) (Volume 4)

Readers may also be interested in the following recent articles that investigate specific factors related to physical activity in children and adolescents.

Babey, S. H., Hastert, T. A., Yu, H. J., & Brown, E. R. (2008). Physical activity among adolescents – "When do parks matter?" *American Journal of Preventive Medicine*, 34(4), 345-348. This study may be available in a library near you or can be purchased online through the publisher at: <http://www.elsevier.com>

de Vries, S. I., Bakker, I., van Mechelen, W., & Hopman-Rock, M. (2007). "Determinants of activity-friendly neighborhoods for children: Results from the SPACE study." *American Journal of Health Promotion*, 21(4), 312-316. This study may be available in a library near you or can be purchased online through the publisher at: <http://www.healthpromotionjournal.com/>

Roemmich, J. N., Epstein, L. H., Raja, S., & Yin, L. (2007). "The neighborhood and home environments: Disparate relationships with physical activity and sedentary behaviors in youth." *Annals of Behavioral Medicine*, 33(1), 29-38. This study may be available in a library near you or can be purchased online through the publisher at: <http://www.springer.com/psychology/health+and+behavior/journal/12160>

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### **Many U.S. children are vitamin D deficient and this deficiency is associated with cardiovascular risk factors**

Vitamin D is primarily produced in the skin after exposure to sunlight and is essential for calcium absorption and may be important to numerous other body processes. In this study, Kumar and colleagues investigated the prevalence of vitamin D deficiency among U.S. children and whether vitamin D deficiency is associated with cardiovascular risk factors. The researchers analyzed data for nearly 10,000 children from the 2001-2004 National Health and Nutrition Examination Survey (NHANES), a nationally representative survey of the U.S. population where participants were interviewed and given physical examinations. In analyzing the data, Kumar and colleagues found that 9% of 1- to 21-year-old children were vitamin D deficient, representing 7.6 million U.S. children, and 61% were vitamin D insufficient, representing 50.8 million U.S. children. In examining factors associated with vitamin D deficiency, researchers found that children who were older, female, non-Hispanic black or Mexican American, obese, drank milk less than once a week, did not take vitamin D supplements, and were engaged in more than 4 hours of screen time a day, were more likely to be vitamin D deficient. In addition, Kumar and colleagues found that vitamin D deficiency was associated with a number of cardiovascular risk factors, including higher systolic blood pressure and higher lipoprotein cholesterol, when compared to children without vitamin D deficiency. While this study may be limited due to its cross-sectional design, Kumar and colleagues' work using a large, nationally representative sample provides valuable information on an understudied topic.

Author Affiliation: Kumar, Kaskel, and Melamed are with the Albert Einstein College of Medicine in New York. Muntner is with the Mount Sinai School of Medicine in New York. Hailpern is with the Centers for Disease Control and Prevention.

Kumar, J., Muntner, P., Kaskel, F. J., Hailpern, S. M., & Melamed, M. L. (2009). Prevalence and associations of 25-Hydroxyvitamin D deficiency in US children: NHANES 2001-2004. *Pediatrics*(August 3). This study may be available in a library near you or can be purchased online through the publisher at: <http://www.jpeds.com/> (Volume 4)

Readers may also be interested in the following related articles:

Reis, J. P., von Muhlen, D., Miller, E. R., Michos, E. D., & Appel, L. J. (2003). Vitamin D status and cardiometabolic risk factors in the United States adolescent population. *Pediatrics*(August 3).

Misra, M., Pacaud, D., Petryk, A., Collett-Solberg, P. F., & Kappy, M. (2008). Vitamin D deficiency in children and its management: Review of current knowledge and recommendations. *Pediatrics*, 122(2), 398-417.

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### Many children and adolescents are vitamin D deficient

Worldwide, there is a high prevalence of vitamin D deficiency among infants, children, and adolescents. Vitamin D deficiency is a risk factor for rickets and may be a risk factor for development of a number of chronic diseases, such as cardiovascular diseases and cancer. In this paper, S.Y. Huh and C.M. Gordon review the sources of vitamin D, which includes endogenous synthesis (the first step of which is the absorption of ultraviolet B radiation), how vitamin D deficiency is defined and measured, and the prevalence of and risk factors for vitamin D deficiency, which includes reduced sun exposure. In addition, the authors review the health effects of vitamin D deficiency and its prevention and treatment. Huh and Gordon stress the importance of additional research to determine the optimum concentration of vitamin D for children of different ages and to compare different regimens designed to prevent and treat vitamin D deficiency as well as to better understand short and long-term impacts on critical health outcomes.

Huh, S. Y., & Gordon, C. M. (2008). "Vitamin D deficiency in children and adolescents: Epidemiology, impact and treatment." *Reviews in Endocrine & Metabolic Disorders*, 9(2), 161-170. This study may be available in a library near you or can be purchased online through the publisher at: <http://www.springer.com/medicine/internal/journal/11154>

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### Street trees may help prevent early childhood asthma

The prevalence of childhood asthma in the U.S. has increased dramatically in the past 20 years and is particularly high in poor urban communities. While the exact cause for this increase remains unknown, environment and lifestyle changes are believed to be possible contributors. Trees may help prevent asthma by changing local air quality or by encouraging children to play outdoors, exposing them to a variety of microbes. In this study, G.S. Lovasi and colleagues investigate whether there is an association between street trees and childhood asthma by examining data, grouped by specific hospital geographic areas, on the prevalence of asthma for 4-year-old and 5-year-old children, hospitalizations as a result of asthma for children younger than 15, number of street trees, census data, and proximity to pollution sources. In analyzing the data, the authors found that higher street density was associated with a lower prevalence of childhood asthma, but that there was not a significant association between street trees and hospitalizations. In their analysis, Lovasi and colleagues controlled for a number of other factors that may have influenced the results, such as proximity to pollution sources and sociodemographic characteristics. Based on these findings, the

authors estimate that an increase in tree density of 343 trees per square kilometer would be associated with a 29% lower prevalence of early childhood asthma. It is important to note that this analysis does not demonstrate that trees cause or prevent asthma for an individual child. While the results of this study are encouraging, additional research is needed to better understand the effects of trees on the prevalence of childhood asthma.

Lovasi, G. S., Quinn, J. W., Neckerman, K. M., Perzanowski, M. S., & Rundle, A. (2008). "Children living in areas with more street trees have lower prevalence of asthma." *Journal of Epidemiology and Community Health*, 62(7), 647-649. This study may be available in a library near you or can be purchased online at: <http://jech.bmj.com/> (Volume 3)

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### **Spending time outdoors helps prevent myopia in 12-year-olds**

In recent decades, myopia or nearsightedness has become increasingly common in young children. While the cause(s) of myopia remain unknown, environmental factors, such as reading that requires children to focus at a close distance, are thought to play an important role. Using data from the Sydney, Australia Myopia study, K. A. Rose and colleagues investigate the relationship between near work, midworking distance, and outdoor activities with the prevalence of myopia in 6- and 12-year-old children. Between 2003 and 2005, 1,765 6-year-olds and 2,367 12-year-olds received a comprehensive eye exam and completed questionnaires about their activities during weekdays and weekends (parents completed the questionnaires for the 6-year-old children). The authors grouped children's activities into near work (e.g., drawing and reading), midworking distance (e.g., watching television and using the computer), and outdoor activities (e.g., bicycle riding and outdoor sport). After adjusting for a number of potentially confounding factors (e.g., parental myopia and ethnicity), Rose and colleagues found that while there was no association between the prevalence of myopia and activity among 6-year-olds that higher levels of total time spent outdoors were associated with a lower prevalence of myopia among 12-year-olds. The authors found that 12-year-olds with the highest levels of near work activity and lowest levels of outdoor activity were two to three times more likely than their peers to develop myopia, whereas 12-year-olds with the lowest levels of near work activity and highest levels of outdoor activity were less likely than their peers to develop myopia. The authors also found that participation in sports did not seem to be a significant factor in explaining this protective effect. Rose and colleagues suggest that light intensity may be an important factor in explaining the impact of outdoor activity on the development of myopia and that additional research is needed to help understand this relationship.

Rose, K. A., Morgan, I. G., Ip, J., Kifley, A., Huynh, S., Smith, W., et al. (2008). Outdoor activity reduces the prevalence of myopia in children. *Ophthalmology*, 115(8), 1279-1285. This study may be available in a library near you or can be purchased online at: <http://www.ajo.com/>. (Volume 3)

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### **Play in natural environments improves kindergarten children's motor abilities**

Fjortoft examined the impact of kindergarten children's play environment on their motor development in Telemark, Norway. As part of this study, one kindergarten group, consisting of 46 children, was provided opportunities to play in a nearby 19 acre forest for one to two hours a day, while the other kindergarten group, consisting of 29 children from two kindergartens, continued to play on traditional playgrounds for one to two hours a day. Fjortoft conducted a pre-test of all children's motor fitness, followed by a 9 month observational period and post-test. With regard to children's motor abilities, she found that play in the natural environment improved all motor abilities except flexibility. In the comparison group, however, children's motor fitness improved in only 3 of

the 9 motor tests. When examining differences between the two groups, Fjortoft found the experimental group to be significantly better than the comparison group in terms of balance and coordination.

Fjortoft, I. (2004). *Landscape as playscape: the effects of natural environments on children's play and motor development*. *Children, Youth and Environments, 14(2)*, 21-44. This article is available online at: [http://www.colorado.edu/journals/cye/index\\_issues.htm](http://www.colorado.edu/journals/cye/index_issues.htm).

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### ***Focus: Other Health Benefits***

These articles highlight other health benefits from children's contact with the outdoors and/or nature, as well as benefits to children's development of life assets, such as attitudes and behaviors towards the environment.

### **Green School Gyms improve children's health**

BTCV is a charitable organization in the United Kingdom that created Green Gyms to improve people's health and the environment. As part of Green Gyms, individuals participate in a range of conservation and gardening projects outdoors, such as planting trees and constructing footpaths. From 2007 to 2009, BTCV implemented Green Gyms in 9 primary schools. As part of these School Green Gyms, a weekly 1 to 1.5 hour session was provided for 10 weeks for groups of about 10 children at each school. During these sessions, children participated in environmental activities on their school grounds or nearby open spaces. BTCV commissioned a university to evaluate the School Green Gyms. As part of this evaluation, children completed a questionnaire before and after participation in the program. In analyzing the data, researchers found that children's psychosocial health and overall health significantly improved after the Green Gyms program. In addition, they found that children's weekend physical activity levels significantly increased after the program and that children felt very positive about the program. While the study data is based on self-reported information and it is difficult to separate the impact of the program activities from the outdoor context, this evaluation provides valuable information about the impact of an innovative program on children's health.

**BTCV. (2009). Evaluation findings: health and social outcomes 2009. BTCV.** This report is available online at: [http://www2.btcv.org.uk/display/greengym\\_research](http://www2.btcv.org.uk/display/greengym_research) (Volume 4)

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### **Children benefit from appropriate risk-taking during outdoor play**

Play is critical to children's healthy development. Little and Wyver examine outdoor play with a focus on early childhood education and urban Western culture. The authors review a number of social and environmental factors that have influenced children's outdoor play experiences in recent years (e.g., traffic, lack of space, other time demands, and parental fears). Little and Wyver discuss the importance of children's experience with risk to healthy development, including children's ability to develop and refine their motor skills and enjoy and gain confidence in being physically active. The authors also review literature related to the impacts of not providing children with opportunities to engage in challenging and risk-related experiences, including children's engagement in inappropriate risk-taking and underdevelopment of decision-making skills related to making sound risk judgments. Little and Wyver discuss the inability of many early childhood educators to provide challenging and stimulating outdoor experiences to children due to restrictive regulations and a cultural emphasis on



eliminating or minimizing physical risk. The authors review the difference between “hazard” and “risk” and emphasize the importance of considering risk within the larger context of children’s development, as well as the need to focus on identifying and fostering a risk balance that is appropriate for each individual child. In concluding their article, Little and Wyver articulate a model they developed that illustrates possible pathways from specific factors (e.g., poor outdoor environments or fear of litigation) to minimization of risk-taking and developmental outcomes, and emphasize the need to examine early childhood education policy and practice.

Author Affiliation: The authors are with Macquarie University in Australia.

**Little, H., & Wyver, S. (2008). Outdoor play - does avoiding the risks reduce the benefits? *Australian Journal of Early Childhood*, 33(2), 33-40.** This study may be available in a library near you or can be purchased online through the publisher at: [http://www.earlychildhoodaustralia.org.au/australian\\_journal\\_of\\_early\\_childhood/about\\_ajec.html](http://www.earlychildhoodaustralia.org.au/australian_journal_of_early_childhood/about_ajec.html) (Volume 4)

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### **Outdoor experience for teens has self-reported life-changing results**

A classic 1998 study by Dr. Stephen R. Kellert of Yale University, with assistance from Victoria Derr, remains the most comprehensive research to date to examine the effects on teenage youth of participation in outdoor education, specifically wilderness-based programs. Subjects were participants in programs offered through three old and well-respected organizations: the Student Conservation Association (SCA), the National Outdoor Leadership School (NOLS), and Outward Bound. The researchers used quantitative and qualitative research techniques, and parallel use of both retrospective and longitudinal study techniques. Results indicate that the majority of respondents found this outdoor experience to be “one of the best in their life.” Participants report positive effects on their personal, intellectual and, in some cases, spiritual development. Pronounced results were found in enhanced self-esteem, self-confidence, independence, autonomy and initiative. These impacts occurred among both the retrospective and longitudinal respondents in this study, which means, in part, that these results persisted through many years.

**Kellert, Stephen R.; with the assistance of Victoria Derr. “A National Study of Outdoor Wilderness Experience.” New Haven: Yale University, 1998.**

<http://www.nols.edu/resources/research/pdfs/kellert.complete.text.pdf> (Volume 1)

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### **Access to nature nurtures self-discipline**

This study focuses on the positive benefits to inner city youth, particularly girls, from access to green spaces for play. Even a view of green settings enhances peace, self-control, and self-discipline. While the results are most notable for girls, the evidence is not limited to the positive impact on girls. (Original Research)

**Taylor, Andrea Faber; Frances E. Kuo; and William C. Sullivan. “Views of Nature and Self-Discipline: Evidence from Inner City Children.” In the *Journal of Environmental Psychology*, 21, 2001. © 2001 Academic Press. Available on the Web site of the University of Illinois Urbana-Champaign.**

<http://www.lhhl.uiuc.edu/> (Volume 1)

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