

Physical Activity Patterns of Adolescents in Rural India: An Examination of Gender Differences

INTRODUCTION

Physical activity is associated with many health benefits, including weight maintenance, lowered risk factors for non-communicable diseases (NCDs), cardiovascular fitness, improved skeletal health, and psychological health (Kahn et al., 2005; Dept of Health, 2004; Jago et al., 2005; Parfitt & Eston, 2005; Jago et al., 2004). Yet, researchers estimate that around 31% of adults and 80% of adolescents (aged 13-15) do not engage in enough physical activity (Hallal et al., 2012a), defined as 150 min per week of moderate intensity physical activity for adults and 60 minutes of moderate to vigorous physical activity for children and adolescents (U.S. HHS, 2008; WHO, 2011b). Special attention should be paid to physical activity in adolescence, when many disease risk factors first begin to develop and life-long physical activity behaviors are most modifiable. The global decline in adolescent physical activity is a serious public health issue (Biddle et al., 2004; Jago et al., 2008; Marcus et al., 2000, Swaminathan et al., 2011), that is associated with rising rates of NCDs and globalization. This decline is more pronounced in girls compared to boys (Livingstone et al., 2003; Sallis et al., 1993), just one of many indications that gender differences exist in adolescent physical activity.

In developing countries, like India, where the effects of globalization are rapidly taking effect, the risk of physical inactivity for adolescents is quickly growing as secular changes in the home reduce the need for everyday physical activity. In countries like India, where gender norms largely dictate male and female roles in the family and in society (Desai,

1995), gender differences in physical activity are likely to be the most pronounced. This has both short-term and long-term health implications that differ for boys and girls. Therefore, the study of adolescent physical activity in India, and associated gender differences, is needed.

Still, little data exist on physical activity patterns for low- and middle-income countries, with few surveillance measures of physical activity in place (Hallal et al., 2012b). In 2012, we collected a rich new dataset through a school-based survey in the city of Bijapur, India, which includes extensive questions on family and school environment, 24-hour activity diaries, and directly measured anthropometrics on 404 adolescents, their mothers, and an opposite-sex sibling. The purpose of the study on which we report here was to characterize the physical activity patterns of adolescent boys and girls, aged 13 to 16, in this rural city of southern India. Gender differences in physical activity were examined to determine if girls and boys spent similar or different amounts of time in physical activity and if they engaged in different types of physical activity. How boys and girls choose to engage in physical activity may be influenced by their gender-specific role in society, in terms of responsibilities, family expectations, and what resources they have available.

Background

Physical activity in India

In India, physical inactivity is thought to account for 2.6% of coronary heart disease cases, 3.2% of type 2 diabetes cases, 4.8% of breast cancer cases, 4.6% of colon cancer cases, and 4.2% of all-cause mortality (Lee et al., 2012). Asian populations experience increased risk of type 2 diabetes at lower BMI values compared to other racial/ethnic groups

(Ramachandran et al., 2012), and, compared to other populations worldwide, the Indian population experiences first myocardial infarction earlier in life. Therefore, more research on physical activity is warranted in the Indian population.

A number of studies have examined physical activity patterns in different ways among Indian youth (Swaminathan & Vaz, 2013). A study conducted in Hyderabad (Laxmaiah et al., 2007) found that participation in different types of activities, or activity domains, varied. Only 18% of adolescents did not participate in household activities, while nearly half (44%) did not participate in outdoor games (Laxmaiah et al., 2007). Many adolescents engage in transport physical activity as evidenced by 57% of adolescents reporting walking or biking to school (Guthold et al., 2010). On average, Indian adolescents engage in approximately 62 minutes of MVPA per day, meeting the recommended daily 60 minutes of MVPA (Vaz et al., 2011). While physical activity is universally known to decrease throughout adolescence, MVPA among adolescents in India has been found to decrease in as little as 1 year (Swaminathan et al., 2011). Across all studies, girls were found to exhibit lower physical activity than boys (Swaminathan & Vaz, 2013), which is consistent with international literature. Compared to boys, girls in India engage less in outdoor play, games and sports (Swaminathan & Vaz, 2013; Thakor et al., 2004).

Though these studies provide a foundation of research on physical activity in Indian youth and gender differences therein, varying methods, sample sizes and outcome parameters leave much in question (Swaminathan & Vaz, 2013). Findings are difficult to compare between studies because common methodologies and instruments were not employed. Nine of the 11 studies reviewed by Swaminathan and Vaz (2013), and mentioned here, were conducted in urban settings, leaving a gap in the literature regarding rural settings.

More information is needed to understand physical activity across its multiple domains, as well as the determinants of physical activity at the individual, family and community levels (Swaminathan & Vaz, 2013).

In India, cultural preference for boys over girls indicates that gender-based preferential treatment occurs. In terms of the home environment and family influences, this preference for boys plays into family resource allocation (Sharma et al., 2011; Jatrana et al., 2003). Girls are thought to be devalued in the Indian family, and often carry a heavy domestic workload (Desai, 1995). In terms of physical activity, this could mean less restrictive rules for boys than for girls, creating disparity between boys and girls' physical activity behaviors. More attention should be paid to gender differences regarding physical activity, especially in the context of non-Western countries where gender norms differ.

Time use surveys for measuring physical activity

A common method for capturing physical activity, which we used in our study, is time-use diaries. Time-use surveys have several advantages over other physical activity measurement tools. They allow respondents to record when activities actually began and ended, rather than tailoring the start and end times of activities to pre-determined periods of time, as is customary with activity diaries. For youth, this is especially important in that physical activity bouts are often unplanned and short-term (Corder et al., 2008). Time-use surveys are comprehensive measures in that they measure what activities are performed and how long the activities lasted, as well as where the activities took place and with whom they were completed. This is especially important in understudied populations where physical activities may differ significantly from other (more-studied) populations, due to various

factors, like SES or cultural factors. This measure of physical activity is also advantageous in that it may capture physical activities of girls, such as household activities, that have previously been overlooked.

Data

Data used for this study were collected in the city of Bijapur in the spring of 2012. Home to approximately 326,360 people, the city of Bijapur is located within Bijapur District, in the state of Karnataka, India (Census, 2011). The population of the district has grown drastically over the last decade, from 1,806,918 in 2001 to 2,175,102 in 2011—an increase of over 20% (Census, 2011). Though Bijapur is considered a rural city, with 77% of the population residing in rural areas, and 23% in urban areas (Census, 2011), it is becoming increasingly urbanized given ongoing population growth.

Participants were male and female children between the ages of 13 and 16, who were attending schools, both private and public, in the city of Bijapur. From 32 secondary schools in Bijapur, three private and three public schools were randomly selected. From the selected schools' rosters, 407 adolescents were selected, 201 from public schools (102 boys, 99 girls) and 206 from private schools (105 boys, and 101 girls), using simple random sampling. The mothers or primary caregivers of these adolescents were also sampled. Nine adolescents did not have data from both the 24-hour recall and the caregiver interview. These participants with incomplete data were not included in analysis, yielding a final sample of 395 participants.

A 24-hour time-use survey (see Figure 3), adapted from the Panel Study of Income Dynamics (PSID) Child Supplement Weekday Time Diary (PSID, 2007), was used to record

all activities that adolescents engaged in over a 24-hour period. The coding scheme for the adapted time-use survey was created by Emory researchers, in collaboration with the Bijapur team, and can be seen in Table 1. Additionally, a questionnaire for the mother/primary caregiver was used to assess the home environment of each adolescent; questions used from this instrument are described in the measures section.

Data were collected by a team of 8 interviewers and 2 supervisors. Data collection took place during the months of February, March and April, 2012. Adolescents were asked to fill out the 24-hour time-use survey at school, with the assistance of interviewers. Participants also received a home visit, during which interviewers collected demographic and home environment information from adolescents' mothers or primary caregivers using the caregiver questionnaire. A few items were chosen from this interview to include in our study, which are discussed further in the measures section.

Methods

In order to characterize physical activity patterns in the sample, physical activities first had to be identified. Based on the literature, the following activities were identified as physical activities: active play outdoors, active play indoors, biking to a destination or for fun, walking or running to a destination or for fun, shopping for household items, shopping for clothes or games, shopping for snacks or tobacco or drinks, errands, preparing food, serving food, meal cleanup, indoor cleaning, laundry, home repairs and outdoor chores, other indoor things around the house, other outdoor chores, vehicle care, work outside the home, gardening, and playing with younger child. Though listed as a single activity, work outside the home referred to a variety of paid jobs, like working in a garage, polishing shoes,

and distributing newspapers on a bike, all of which can be considered moderate to high physical labor. Physical activities were organized into the following physical activity domains: *sleeping and passive activities, shopping and errands, self-care, eating, household chores, work outside the home, school, active play, travel, child and plant care*. A domain variable was created to indicate what domain each activity corresponded to. All physical activities and their corresponding domains are highlighted in Table 2.

In order to examine gender differences in physical activity, we first had to establish what the levels of physical activity were among this population, by looking at total duration of physical activity, duration of individual activities, and duration of activity within specific domains. We also looked at how many adolescents engaged in any physical activity, how many engaged in individual activities, and how many engaged in specific domains. Then gender differences in physical activity were examined, for all of these measures. The following details what measures were used and how they were developed.

In preliminary estimates, we have created several measures of physical activity patterns dealing with duration (total duration of physical activity; duration of each activity; duration of each type or domain of activities); frequency of doing physical activity; participation (participation in any physical activity; in each activity; and in each domain of activities).

To better understand the context of physical activity and gender differences therein, we explored parental rules about boys and girls playing outside and household domestic help responsibilities. Multivariate regressions will also control for school type, caste, household education level, and monthly household income.

Preliminary results

The sample for this study was 395 adolescents, of whom about half were male (n=197), and the other half female (n=198). All adolescents were between the ages of 13 and 16 years old. Half of the sample attended public schools (n=197, 50%), with the other half attending private schools (n=198, 50%). Among the adolescents' primary caregivers, about 18% were not formally educated (n=70). Of those who were educated, 14% completed primary school (n=55), 18% completed high school (n=72), 11% completed Pre University Course (PUC) (n=42), 34% completed a degree (n=133), and less than 10% had completed a professional degree (n=23, 6%). In terms of income, 14% of adolescents came from a household with a monthly income of less than 5,000R (n=55). Around a third of households had a monthly income of 5,000-10,000R (n=124, 31%), and the remaining 53% had a monthly income of more than 10,000R (n=211). In terms of caste, 55% of families were of other backward classes. A quarter of families were of general caste (n=99, 25%), and around 20% of families were of scheduled caste or scheduled tribe (n=74, 19%; n=6, 2%, respectively). Demographics can be seen in Table 3.

The majority of the sample (92%) took part in one or more physical activities during the day, with no significant differences seen between males and females. Adolescents reported taking part in anywhere from 0 to 690 minutes of physical activity per day, with the average being 124 minutes, about 2 hours, of physical activity. Duration of physical activity was similar between males, at 131 minutes, and females, at 117 min. Adolescents reported between 0 and 16 physical activity bouts per day, with 3 physical activity bouts per day being the average. Males and females did not significantly differ in terms of frequency of physical activity, both averaging 3 bouts of activity per day. Over 90% of adolescents participated in

at least one physical activity, with no significant differences seen between male participation (92%) and female participation (91%). Approximately 68% of adolescents completed at least 60 minutes of physical activity (n=268), with no significant differences between males (69%) and females (66%). Refer to Table 4.

Duration by Activity

Among physical activities, adolescents spent the most time walking or running (mean=39min), in active play outdoors (mean=27min), and biking (mean=10min). In general, the same amount of time was spent shopping for household items (mean=5min), doing errands (mean=4min), cleaning indoors (mean=5min), doing paid work (mean=4min), and taking part in active play indoors (mean=5min). Girls spent significantly more time performing many chores compared to boys: preparing food, serving food, cleaning up after meals, cleaning indoors and doing laundry. In contrast, boys spent significantly more time in active play outdoors (mean=42min) than did girls (mean=13min), as well as biking. Mean duration values (in minutes) for every physical activity, overall and by gender, can be found in Table 5.

The physical activity domains included: *shopping and errands*, *household chores*, *work outside the home*, *active play*, *travel*, and *child and plant care* (Table 2). Among these domains, adolescents spent the most time in *active play* (mean=176min), *travel* (mean=92min), and *household chores* (mean=27min). Girls spent significantly more time in the *household chores* domain (mean=41) than did boys (mean=13min) ($t = -5.3$). Mean duration of time spent in each activity domain, overall and by gender, can be seen in Table 6.

More than three quarters of adolescents reported one or more activities in the *travel* domain. Over a third of adolescents reported one or more activities in the *play and social*

activities domain and the *household chores* domain, with more boys activities in the *play and social activities* domain and more girls reporting activities in the *household chores* domain. The number of adolescents who participated in one or more activities for each domain is shown in Table 8.

Discussion

Adolescents reported around 2 hours of physical activity, with no significant difference between girls and boys, and around 3 physical activity bouts in a day. Over 90% of adolescents participated in at least one physical activity and over 67% participated in at least 60 minutes of physical activity. Among all physical activities, the most time was spent walking/running (mean=39min), in active play outdoors (mean=27min), and biking (mean=10min).

Though boys and girls did not differ in terms of total duration of physical activity, girls spent significantly more time performing the following household chores: food preparation, serving food, meal cleanup, indoor cleaning, and laundry. Moreover, more girls participated in these household chores. Compared to girls, boys spent significantly more time in active play outdoors and biking, and more boys reported these activities.

That girls and boys engaged in similar amounts of physical activity was consistent with our hypothesis as well as international and Indian literature (Swaminathan & Vaz, 2013; Hallal et al., 2012a). Also consistent with our hypothesis was the fact that girls and boys engaged in different types of activities, in terms of individual activities and in terms of activity domains. International literature supports this observation, finding that boys engage in more outdoor activities than girls (Dunton et al., 2010). Indian literature supports the finding that girls engage in less sports activity and MVPA (Swaminathan et al., 2011), much

like the active play in this study. One strong finding was that none of the 197 boys reported meal cleanup, while 33 girls did. This is a clear indication of differing roles of boys and girls in the household.

REFERENCES

- Ainsworth BE, Haskell WL, Whitt MC, Irwin ML, Swartz AM, Strath SJ, O'Brien WL, Bassett DR Jr, Schmitz KH, Emplaincourt PO, Jacobs DR Jr, Leon AS. (2000). Compendium of physical activities: an update of activity codes and MET intensities. *Med Sci Sports Exerc*, 32(9 Suppl), S498-504.
- Biddle, S., Gorely, T., & Stensel, D. (2004). Health-enhancing physical activity and sedentary behaviour in children and adolescents. *J. Sports Sci*, 22, 679-701.
- Boreham, C., & Riddoch, C. (2001). The physical activity, fitness and health of children. *J Sports Sci*, 19, 915–29.
- Caspersen, C.J., Powell, K.E., & Christensen, G.M. (1985). Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public Health Reports*, 100 (2), 126-131.
- Corder, K., Ekelund, U., Steele, R.M., Wareham, N.J., Brage, S. (2008). Assessment of physical activity in youth. *J Appl Physiol*, 105(3), 977-87.
- Craig, C.L., Marshall, A.L., Sjöström, M., et al. (2003). International physical activity questionnaire: 12-Country reliability and validity. *Medicine and Science in Sports and Exercise*, 35(8), 1381–1395.
- Department of Health. (2004). At least five a week: Evidence on the impact of physical activity and its relationship to health. *London*.
- Desai M. (1995). Empowering the family for girl child development. *Soc Change*, 25(2-3), 38-43.
- Dunn, A.L., Andersen, R.E., & Jakicic, J.M. (1998). Lifestyle physical activity interventions. History, short- and long-term effects, and recommendations. *Am J Prev Med*, 15(4), 398-412.
- Dunton, G.F., Berrigan D., Ballard-Barbash, R., Perna, F.M., Graubard, B.I., & Atienza, A.A. (2010). Adolescents' Sports and Exercise Environments in a U.S. Time Use Survey. *American Journal of Preventive Medicine*, 39(2), 122-129.
- Finne, E., Bucksch, J., Lampert, T., & Kolip, P. (2011). Age, puberty, body dissatisfaction, and physical activity decline in adolescents. Results of the German Health Interview and Examination Survey (KiGGS). *Int J Behav Nutr Phys Act*, 8, 119.
- Finnerty, T., Reeves, S., Dabineett, J., Jeanes, Y.M., & Vogelee, C. (2010). Effects of peer influence on dietary intake and physical activity in school-children. *Public Health Nutr*, 13(3), 376-83.
- Government of India, Ministry of Statistics and Programme Implementation. (1999) Time Use Survey (July 1998- June 1999): Brief Details and Important Findings of the Survey. Retrieved from http://www.mospi.nic.in/stat_act_t5_2.htm
- Goyal, J.P., Kumar, N., Parmar, I., Shah, V.B., & Patel, B. (2011). Determinants of Overweight and Obesity in Affluent Adolescent in Surat City, South Gujarat region, India. *Indian J Community Med*, 36(4), 296-300.
- Goyal, R.K., Shah, V.N., Saboo, B.D., et al. (2010). Prevalence of overweight and obesity in Indian adolescent school going children: its relationship with socioeconomic status and associated lifestyle factors. *J Assoc Physicians India*, 58, 151–8.

- Guthold, R., Cowan, M.J., Autenrieth, C.S., Kann, L., & Riley, L.M. (2010). Physical activity and sedentary behavior among schoolchildren: a 34- country comparison. *J Pediatr*, 157, 43–49–e41.
- Hallal, P.C., Andersen, L.B., Bull, F.C., Guthold, R., Haskell, W., & Ekelund, U. (2012a). Global physical activity levels: surveillance progress, pitfalls, and prospects; Lancet Physical Activity Series Working Group. *Lancet*, 380(9838), 247-57.
- Hallal, P.C., Bauman, A.E., Heath, G.W., Kohl, H.W. 3rd, Lee, I.M., & Pratt, M. (2012b). Physical activity: more of the same is not enough. *Lancet*, 380(9838), 190-91.
- Hallal, P.C., Wells, J.C., Reichert, F.F., Anselmi, L., & Victora, C.G. (2006). Early determinants of physical activity in adolescence: prospective birth cohort study. *BMJ*, 332, 1002–7.
- Haskell, W.L., Lee, I.M., Pate, R.R., et al. (2007) Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Circulation*, 116, 1081–93.
- Haskell, W.L., Lee, I.M., Pate, R.R., Powell, K.E., Blair, S.N., Franklin, B.A., Macera, C.A., Heath, G.W., Thompson, P.D., & Bauman, A. (2007). Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Med Sci Sports Exerc*, 39(8),1423-34.
- Jago, R., Baranowski, T., Baranowski, J.C., Thompson, D., & Greaves, K.A. (2005). BMI from 3-6 y of age is predicted by TV viewing and physical activity, not diet. *Int J Obes Relat Metab Disord*, 29, 557-564.
- Jago, R., Baranowski, T., Yoo, S., Cullen, K.W., Zakeri, I., Watson, K., Himes, J.H., Pratt, C., Sun, W., Pruitt, L.A., & Matheson, D.M. (2004). Relationship between physical activity and diet among African-American girls. *Obes Res*, 12 (Suppl), 55S-63S.
- Jago, R., Wedderkopp, N., Kristensen, P. L., Møller, N. C., Andersen, L. B., Cooper, A. R., & Froberg, K. (2008). Six-year change in youth physical activity and effect on fasting insulin and HOMA-IR. *American Journal of Preventive Medicine*, 35(6), 554-560.
- Jain, S., Pant, B., Chopra, H., & Tiwari, R. (2010). Obesity among adolescents of affluent public schools in Meerut. *Indian J Public Health*. 54, 158–60.
- Kahn, R., Buse, J., Ferrannini, E., & Stern, M. (2005). The metabolic syndrome: time for a critical appraisal. Joint statement from the American Diabetes Association and the European Association for the Study of Diabetes. *Diabetologia*, 48, 1684-1699.
- Kuriyan, R., Bhat, S., Thomas, T., Vaz, M., & Kurpad, A.V. (2007). Television viewing and sleep are associated with overweight among urban and semi-urban South Indian children. *Nutr J*, 6, 25.
- Laxmaiah, A., Nagalla, B., Vijayaraghavan, K., & Nair, M. Factors affecting prevalence of overweight among 12- to 17-year-old urban adolescents in Hyderabad, India. *Obesity (Silver Spring)*, 15, 1384–90.
- Lee, I.M., Shiroma, E.J., Lobelo, F., Puska, P., Blair, S.N., & Katzmarzyk, P.T.; Lancet Physical Activity Series Working Group. (2012). Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and

- life expectancy. *Lancet*, 380(9838), 219-29.
- Livingstone M.B.E., Robson, P. J., Wallace, J. M. W., & McKinley M. C. (2003). How active are we? Levels of routine physical activity in children and adults. *Proceedings of the Nutrition Society*, 62, 681-701.
- Loprinzi, P.D., Cardinal, B.J., Loprinzi, K.L., & Lee, H. (2012). Benefits and environmental determinants of physical activity in children and adolescents. *Obes Facts*, 5(4):597-610.
- Lubans, D.R., Morgan, P.J., & Tudor-Locke, C. (2009). A systematic review of studies using pedometers to promote physical activity among youth. *Prev Med*, 48(4), 307-15.
- Marcus, B. H., Forsyth, L. H., Stone, E. J., Dubbert, P. M., McKenzie, T. L., Dunn, A. L., & Blair, S. N. (2000). Physical activity behavior change: Issues in adoption and maintenance. *Health Psychology*, 19(Suppl.), 32–41.
- McCormack, G.R., Giles-Corti, B., Timperio, A., Wood, G., & Villanueva, K. (2011) A cross-sectional study of the individual, social, and built environmental correlates of pedometer-based physical activity among elementary school children. *International Journal of Behavioral Nutrition and Physical Activity*, 8, 30.
- Moore, S.C., Patel, A.V., Matthews, C.E., Berrington de Gonzalez, A., Park, Y., Katki, H.A., Linet, M.S., Weiderpass, E., Visvanathan, K., Helzlsouer, K.J., Thun, M., Gapstur, S.M., Hartge, P., & Lee, I.M.(2012) Leisure Time Physical Activity of Moderate to Vigorous Intensity and Mortality: A Large Pooled Cohort Analysis. *PLoS Med*, 9(11), e1001335.
- Must, A., Tybor, D.J. (2005) Physical activity and sedentary behavior: a review of longitudinal studies of weight and adiposity in youth. *Int J Obes (Lond)*, 29, S84–96.
- Ortlieb, S., Schneider, G., Koletzko, S., Berdel, D., von Berg, A., Bauer, C.P., Schaaf, B., Herbarth, O., Lehmann, I., Hoffmann, B., Heinrich, & J., Schulz, H. (2013). Physical activity and its correlates in children: a cross-sectional study (the GINIplus & LISApplus studies). *BMC Public Health*, 13(1), 349.
- Panel Study of Income Dynamics (2007). The Child Development Supplement: Weekday Time Diary. Produced and distributed by the Institute for Social Research, Survey Research Center, University of Michigan, Ann Arbor, MI.
- Parfitt, G., & Eston, R.G. (2005). The relationship between children's habitual activity level and psychological well-being. *Acta Paediatr*, 94, 1791-1797.
- Physical Activity Guidelines Advisory Committee. Physical Activity Guidelines Advisory Committee Report, 2008. Washington, DC.
- Pratt, M., Macera, C.A., Sallis, J.F., O'Donnell, M., Frank, L.D. (2004). Economic interventions to promote physical activity: application of the SLOTH model. *Am J Prev Med*, 27(3 Suppl), 136-45.
- Puri, S., Marwaha, R.K., Agarwal, N., et al. (2008). Vitamin D status of apparently healthy schoolgirls from two different socioeconomic strata in Delhi: relation to nutrition and lifestyle. *Br J Nutr*, 99, 876–82.
- Ramachandran, A., Chamukuttan, S., Shetty, S.A., Arun, N., & Susairaj, P. Obesity in Asia – is it different from rest of the world. *Diabetes Metab Res Rev*, 28(Suppl 2), 47–51.

- Ridley, K., Ainsworth, B.E., & Olds, T.S. (2008) Development of a compendium of energy expenditures for youth. *Int J Behav Nutr Phys Act*, 5, 45.
- Sallis, J.F., Prochaska, J., & Taylor, W. (2000). A review of correlates of physical activity of children and adolescents. *Med Sci Sports Exerc.* 32, 963–75.
- Sallis, J.F. (1993). Epidemiology of physical activity and fitness in children. *Crit Rev Food Sci Nutr.* 1993;33(4-5):403-8. Review.
- Sallis, J.F., Zakarian, J.M., Hovell, M.F., & Hofstetter, C. R. (1996). Ethnic, socioeconomic, and sex differences in physical activity among adolescents. *Journal of Clinical Epidemiology*, 49(2), 125-134.
- Scheers, T., Philippaerts, R., & Lefevre, J. Assessment of physical activity and inactivity in multiple domains of daily life: a comparison between a computerized questionnaire and the SenseWear Armband complemented with an electronic diary. *International Journal of Behavioral Nutrition and Physical Activity*, 9, 71.
- Singh, A.K., Maheshwari, A., Sharma, N., Anand, K. (2006). Lifestyle associated risk factors in adolescents. *Indian J Pediatr.* 73, 901– 6.
- Sternby, N.H., Fernandez-Britto, J.E., & Nordet, P. (1999). Pathobiological determinants of atherosclerosis in youth (PBDAY Study), 1986-96. *Bull World Health Organ*, 77, 250–7.
- Strong, W.B., Malina, R., Blimkie, C.J., Daniels, S.R., Dishman, R.K., Gutin, B., Hergenroeder, A.C. , Must, A., Nixon, P.A., Pirvarnik, J.M., Rowland, T., Trost, S.G., & Trudeau, F. (2005). Evidence based physical activity for school-age youth. *J Pediatr*, 146, 732-7.
- Swaminathan, S., & Vaz, M. (2013). Childhood physical activity, sports and exercise and noncommunicable disease: a special focus on India. *Indian J Pediatr*, 80(Suppl 1), 63-70.
- Swaminathan, S., Selvam, S., Thomas, T., Kurpad, A.V., & Vaz, M. (2011). Longitudinal trends in physical activity patterns in selected urban south Indian school children. *Indian J Med Res*, 134, 174-180.
- Tandon, P.S., Zhou, C., Sallis, J.F., Cain, K.L., Frank, L.D., & Saelens, B.E. (2012). Home environment relationships with children's physical activity, sedentary time, and screen time by socioeconomic status. *International Journal of Behavioral Nutrition and Physical Activity*, 9, 88.
- Thakor, H.G., Kumar, P., & Desai, V.K. (2007) Effect of physical and mental activity on blood pressure. *Indian J Pediatr*, 71, 307–12.
- U.S. Department of Health and Human Services. (1996). Physical Activity and Health: A Report of the Surgeon General. Atlanta: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion; 1996.
- U.S. Department of Health and Human Services, 2008.
- Vaz, M., Pauline, M., Unni, U.S., et al. (2011). Micronutrient supplementation improves physical performance measures in Asian Indian schoolage children. *J Nutr*, 141, 2017–23.
- WHO. (2011a). Global status report on noncommunicable diseases 2010. *Geneva: World Health Organization*.

WHO. (2011b) Global recommendations on physical activity for health. *Geneva: World Health Organization.*

WHO. (2013a) Physical Activity. Retrieved from
http://www.who.int/topics/physical_activity/en/

WHO. (2013b). What is moderate-intensity and vigorous-intensity physical activity?
Retrieved from:

http://www.who.int/dietphysicalactivity/physical_activity_intensity/en/index.html

Yadav, K., & Krishnan, A. (2008) Changing patterns of diet, physical activity and obesity among urban, rural and slum populations in north India. *Obesity Reviews*, 9(5), 400–408.

Yang, X., Telama, R., Viikari, J., & Raitakari, O.T. (2006). Risk of obesity in relation to physical activity tracking from youth to adulthood. *Med Sci Sports Exerc* 38, 919-25.

FIGURES

Figure 1. Conceptual Framework: How gender norms, through family influence, affect physical activity patterns of adolescent boys and girls in rural India.

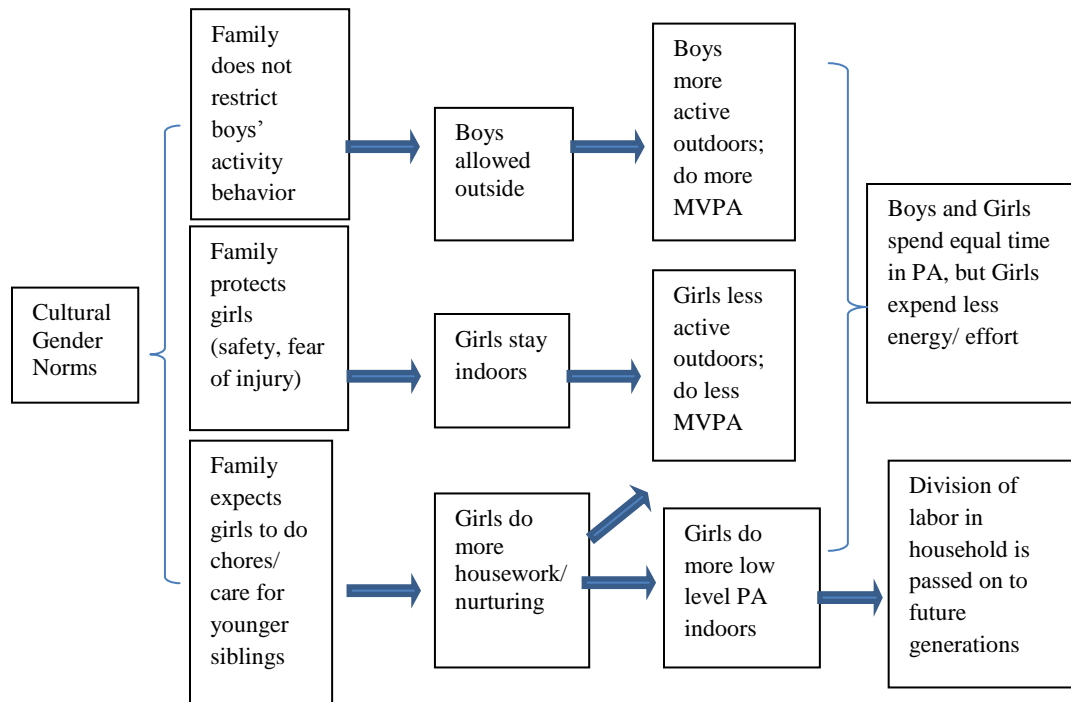


Table 2. Physical Activities listed by Domain

Domain	Physical Activity
Shopping and errands	Shopping for household items Shopping for clothes or games Shopping for snacks, tobacco, drinks Errands
Household chores	Preparing food Serving food Meal cleanup Indoor cleaning Laundry Home repairs and outdoor chores Other indoor things around the house Other outdoor chores Vehicle care
Paid work	Work outside the home
Active play	Active play outdoors Active play indoors
Travel	Biking Walking or running
Child and Plant care	Gardening Playing with younger child

Table 3. Demographic characteristics for adolescents aged 13-16, from public and private schools in Bijapur city, India do not differ between boys and girls (n=395).

Characteristics	Overall	Male	Female	chi2
	%	%	%	
Total	100	49.87	50.13	
School Type				0.00
Public	49.87	49.75	50.00	
Private	50.13	50.25	50.00	
Caste				4.42
General	25.06	22.34	27.78	
Other Backward Classes	54.68	59.9	49.49	
Scheduled Caste	18.73	16.24	21.21	
Scheduled Tribe	1.52	1.52	1.52	
Primary Caregiver's Education				7.45
Not Educated	17.72	19.29	16.16	
Primary	13.92	16.75	11.11	
Secondary	18.23	17.77	18.69	
Pre University Course	10.63	12.18	9.09	
Degree	33.67	29.95	37.37	
Professional	5.82	4.06	7.58	
Monthly household income, in INR, (USD) (n=390)				5.01
<5,000 (\$93)	13.92	17.44	10.77	
5,000-10,000 (\$93-\$186)	31.39	31.79	31.79	
10,000- 20,000 (\$186-\$372)	24.3	24.62	24.62	
20,000-30,000 (\$372-\$558)	16.46	13.85	19.49	
>30,000 (\$558)	12.66	12.31	13.33	

INR = Indian Rupee; USD = US Dollar

*p<0.05, ** p<0.01, ***p<0.001

Table 4. Duration, Frequency, Participation and Met 60min of Physical Activity.

Measure of PA	Total (n=395)				Male (n=197)				Female (n=198)				t-value or chi2	p-value
	mean or %	SD or N	min	max	mean or %	SD or N	Min	max	mean or %	SD or N	min	max		
Duration (min/day)	123.6	109.3	0	690	130.6	115.3	0	690	116.7	102.8	0	480	1.27	0.206
Frequency (bouts/day)	3.2	2.3	0	16	3.2	2.09	0	10	3.2	2.4	0	16	-0.24	0.810
Reported \geq 1 PA (%)	91.90	363			92.39	182			91.41	181			0.13	0.723
Met 60min PA (%)	67.85	268			69.54	137			66.16	131			0.52	0.472

PA = physical activity

*p<0.05, ** p<0.01, ***p<0.001

Table 5. Duration of physical activity (min/day) for school-going adolescents (aged 13-16) in Bijapur, India, by activity.

Activity	Total (n=395)		Male (n=197)		Female (n=198)		t-value	p-value
	mean	SD	mean	SD	mean	SD		
Shopping for household items	4.94	24.48	6.12	31.42	3.76	14.61	0.96	0.340
Shopping for clothes or games	0.19	3.11	0.08	1.07	0.30	4.26	-0.72	0.469
Shopping for snacks, tobacco, drinks	0.16	3.03	0.00	0.00	0.33	4.28	-1.08	0.282
Errands	4.48	22.97	5.51	28.50	3.46	15.65	0.89	0.375
Preparing food	2.71	14.03	0.23	2.39	5.18	19.38	-3.56***	<0.001
Serving food	1.54	11.41	0.20	2.85	2.88	15.76	-2.34*	0.020
Meal cleanup	3.62	14.98	0.00	0.00	7.22	20.55	-4.93***	<0.001
Indoor cleaning	5.41	16.62	1.29	11.26	9.49	19.82	-5.05***	<0.001
Laundry	5.06	19.77	0.33	2.73	9.77	27.01	-4.88***	<0.001
Home repairs and outdoor chores	7.07	31.05	9.11	41.37	5.03	14.75	1.31	0.192
Other indoor things around the house	0.71	4.55	0.89	5.19	0.53	3.82	0.78	0.435
Other outdoor chores	0.72	6.28	0.30	4.27	1.14	7.76	-1.32	0.188
Vehicle care	0.51	4.58	0.94	6.37	0.08	1.07	1.88	0.061
Paid work	4.44	35.60	6.55	43.18	2.35	25.92	1.17	0.242
Active play outdoors	27.34	51.07	41.50	59.49	13.26	35.99	5.71***	<0.001
Active play indoors	5.00	22.26	4.54	23.91	5.46	20.53	-0.41	0.683
Biking	10.49	25.36	17.31	32.15	3.71	12.85	5.52***	<0.001
Walking or running	38.98	60.11	35.68	54.63	42.26	65.08	-0.09	0.277
Gardening	0.05	1.01	0.00	0.00	0.10	1.42	-1.00	0.319
Playing with younger child	0.18	3.52	0.00	0.00	0.35	4.97	-1.00	0.319

*p<0.05, ** p<0.01, ***p<0.001

Table 6. Duration of physical activity (min/day) for school-going adolescents (aged 13-16) in Bijapur, India, by activity domain.

Domain	Total (n=395)		Male (n=197)		Female (n=198)		t-value	p-value
	mean	SD	mean	SD	mean	SD		
Shopping and errands	9.9	34.54	11.7	43.65	8.1	21.99	1.04	0.298
Household chores	27.3	54.35	13.3	44.48	41.3	59.54	-5.30***	<0.001
Work outside the home	4.4	35.60	6.6	43.18	2.4	25.92	1.17	0.242
Active play	176.4	134.97	181.1	134.30	171.7	135.82	0.69	0.490
Travel	92.1	84.81	96.4	88.90	87.8	80.54	1.00	0.318
Child and plant care	1.8	10.85	0.9	7.96	2.7	13.07	-1.69	0.092

*p<0.05, ** p<0.01, ***p<0.001

Table 7. Participation of school-going adolescents (aged 13-16), in Bijapur, India, in each physical activity.

Activity	Total (n=395) %	Male (n=197) %	Female (n=198) %	Chi2	p-value
Shopping for household items	8.86	9.14	8.59	0.04	0.847
Shopping for clothes or games	0.51	0.51	0.51	0.00	1.000
Shopping for snacks, tobacco, drinks	0.51	0.00	1.01	2.00	0.157
Errands	8.35	7.61	9.09	0.28	0.596
Preparing food	5.82	1.02	10.61	16.56***	<0.001
Serving food	3.54	0.51	6.57	10.60**	0.002
Meal cleanup	8.35	0.00	16.67	38.83***	<0.001
Indoor cleaning	15.44	3.05	27.78	46.26***	<0.001
Laundry	9.37	1.52	17.17	28.48***	<0.001
Home repairs and outdoor chores	11.90	10.15	13.64	1.14	0.285
Other indoor things around the house	2.53	3.05	2.02	0.42	0.543
Other outdoor chores	1.77	0.51	3.03	3.61	0.122
Vehicle care	2.03	3.55	0.51	4.62*	0.037
Paid work	2.28	3.55	1.01	2.87	0.105
Active play outdoors	32.91	46.94	19.70	31.40***	<0.001
Active play indoors	8.10	5.58	10.61	3.35	0.067
Biking	20.51	31.47	9.60	28.99***	<0.001
Walking or running	67.09	54.97	69.19	0.80	0.372
Gardening	0.25	0.00	0.51	1.00	1.000
Playing with younger child	0.51	0.00	1.01	2.00	0.499

*p<0.05, ** p<0.01, ***p<0.001

Table 8. Participation of school-going adolescents (aged 13-16) in Bijpaur, India, in each activity domain.

Domain	Total (n=395)		Male (n=197)		Female (n=198)		Chi2	p-value
	N	%	N	%	N	%		
Shopping and errands	67	16.96	32	16.24	35	17.68	0.14	0.704
Household chores	139	35.19	38	19.29	101	51.01	43.57***	<0.001
Work outside the home	9	2.28	7	3.55	2	1.01	2.87	0.105
Active play	152	38.48	98	49.75	54	27.27	21.07***	<0.001
Travel	305	77.22	156	79.19	149	75.25	0.87	0.351
Child and plant care	3	0.76	0	0.00	3	1.52	3.01	0.248

*p<0.05, ** p<0.01, ***p<0.001