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Testing Multi-Theory Model (MTM) in Predicting Physical Activity Behavior Among Upper Elementary School Children in Northern India

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Abstract

Introduction: Physical inactivity in children is a precursor to childhood obesity, which is a major public health concern due to its increasing prevalence over the years. Aim of this study was to predict physical activity (PA) behavior among upper elementary school children from Northern India through Multi -Theory Model (MTM).
Methods: The Multi-Theory Model (MTM) was used to predict PA behavior among 214 upper elementary school children in District Ambala, Haryana, India. A 38-item Physical Activity (PA) questionnaire was used to assess the constructs of MTM. Significant predictors of PA behaviour change (i.e., initiation and sustenance) were assessed by using stepwise multiple regression.
Results: Our findings showed that the mean for the intention to initiate engaging in 60 minutes of physical activity every day in the upcoming week was 2.14 units (SD = 1.23, possible range 0-4 units). The initiation model explained 12.5% variance in the intention to start PA behavior change. Sustenance model explained 5.3% of the variance in the intention for the sustenance of 60 minutes of PA every day. Examining the sustenance model, two constructs of emotional transformation ($\beta = 0.169$, $P = 0.012$) and practice for change ($\beta = 0.177$, $P = 0.008$) were significant predictors.
Discussion and Conclusion: In conclusion, MTM is a useful framework to design interventions to promote physical activity among upper elementary school children in India. More empirical work needs to be undertaken in India, using randomized controlled trials that operationalize expanded form of this model.

KEY WORDS: Children; health behaviour; India; Multi Theory Model; physical activity.

Riassunto

Introduzione: L'inattività fisica nei bambini è un precursore di obesità infantile, che è un importante problema di sanità pubblica a causa della sua prevalenza in aumento nel corso degli anni. L'obiettivo di questo studio è stato quello di prevedere il comportamento relativo all'attività fisica nei bambini di scuola elementare dell'India del Nord attraverso il Modello Multi-Teorico (MTM).
Metodi: Il Modello Multi-Teorico (MTM) è stato usato per predire il comportamento legato all'attività fisica in 214 bambini di scuola elementare nel distretto di Ambala, in Haryana, India. Un questionario a 38 item relativi all'attività fisica è stato usato per i costrutti del modello MT. Significativi predittori di cambiamento nel comportamento relativi all'attività fisica (ovvero di inizio e mantenimento) sono stati valutati attraverso la regressione multipla stepwise.
Risultati: I nostri risultati hanno evidenziato che la media per l'intenzione di iniziare ad impegnarsi in 60 minuti di attività fisica al giorno nella settimana successiva è risultata pari a 2.14 (DS = 1.23, possibile range 0-4 unità). Il modello di inizio ha spiegato il 12,5% di varianza nell'intenzione di iniziare il cambiamento nel comportamento relativo all'attività fisica. Il modello di mantenimento ha spiegato il 5,3% della varianza nell'intenzione di mantenere 60 minuti di attività fisica ogni giorno. Esaminando il modello di mantenimento, due costrutti, quello di trasformazione emotiva ($\beta = 0.169$, $P=0.012$) e di pratica per il cambiamento ($\beta = 0.177$, $P = 0.008$) sono risultati essere predittori significativi.
Discussione e Conclusione: In conclusione, il modello MTM è un utile framework per progettare interventi per promuovere l'attività fisica nei bambini di scuola elementare in India. Ulteriori studi empirici devono essere impiegati in India, usando trial clinici controllati randomizzati che rendano operativa la forma espansa di tale modello.

TAKE-HOME MESSAGE

Our study shows that MTM can be used to predict physical behavior in Indian children. With further efficacy trials, the growing public health threat of physical inactivity among school-going children can be addressed effectively.

Competing interests - none declared.

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INTRODUCTION

Engaging in physical activity (PA) is an important determinant of health among school-aged children [1]. The World Health Organization (WHO) defines PA as "any bodily movements produced by large skeletal muscles that require energy expenditure" [2]. PA at any intensity, from light to moderate and vigorous, is an important piece in the 'movement continuum', which includes behaviours of sleep and sedentary time [3]. At least 60 minutes of daily moderate to vigorous physical activity (MVPA) is recommended for children and youth, aged 5 to 17 years, in India [4]. Improved mental and cardiometabolic health coupled with musculoskeletal growth and development in physically active children provides an optimal foundation at this stage of their life [1, 3, 5]. Positive exercise habits inculcated in childhood tend to carry over into adulthood, thus helping reduce premature death and illness in the future. Cancers, especially breast and colon (21-25%), diabetes (27%) and ischaemic heart disease (30%) have been linked to physical inactivity [2].

Physical inactivity in children is a precursor to childhood obesity, which is a major public health concern due to its increasing prevalence over the years [6]. WHO reports an estimate of 41 million children under age 5 to be obese [2]. Empirical evidence highlights that the upward trend in obesity rates among children will lead to obesity in approximately 70 million children by the year 2025 [7]. Despite the critical importance of PA and publication of guidelines, children tend to be less than optimally active and be overweight and obese [8]. Children spend considerable time in schools, where a dedicated physical education (PE) curriculum promises to support a potential increase in PA [9, 10]. However, in Asia, only 25% of the countries consider PE to have equal legal recognition as with other subjects taught in schools. This is a much lower recognition than globally (76%) and in European Union countries (91%) [11]. India, with a mix of small and big cities and rural tracts, is witnessing a concerning proportion of inactive, overweight and obese children [12, 13]. The *India 2018 Report Card on Physical Activity for Children and Youth* concluded that children have been found not to compensate for PA after school when opportunities are restricted during the school day [14]. In the hours after school, PA levels in children are reduced due to increased screen time watching television, using computers, tablets, iPads, and smartphones [15]. Applying the socio-ecological model to understand the determinants of 'active living', children in India, they are less likely to be supported by their familial, social, political and physical environments to be active [14].

PA behavior among upper elementary school children in India has not been studied well especially utilizing behavioural theoretical frameworks. Upper elementary age is a crucial period in one's life when behaviours are getting formed and cognitive level has reached a point where the child starts to make independent decisions. Considering this view, a need was felt to carry out an assessment of the PA level and its determinants from a theoretical perspective sample of upper elementary school-going children in Northern India. From the review of the evidence, it has been observed that behavioural theories such as social cognitive theory (SCT) [16] have been used in understanding the constructs of PA behavior in children, but found lacking in explaining very little variance in behaviours, especially among Indian children [17]. In a US-based study, relationships among five constructs (self-efficacy, outcome expectations, social support, barriers, and goals) and PA participation were measured, but results have not been very encouraging and very little variance was explained by these constructs [18].

The Health Belief Model (HBM) has also been used in primary school children in Thailand to examine the cues, perceived benefits, and perceived barriers on the level of physical activity [19]. This study also had mixed and inconsistent results, where some perceived barriers affected physical activity but cues to action or perceived benefits had no role [19]. The socio-ecological framework assesses va-

rious factors underlying three socio-ecological dimensions of intrapersonal, interpersonal, and community and environmental resources [20]. A systematic review of such interventions has found these approaches to be somewhat encouraging but the methods based on this framework are difficult to operationalize and replicate [20, 21]. Recent developments in health behaviour research have introduced fourth-generation multiple theory interventions [22].

One such approach is the Multi-Theory Model (MTM) of health behaviour change that is parsimonious and breaks down the change into initiation and sustenance predicting one time and long-term health behavior change, respectively [23]. Constructs of initiation of health behaviour change play a crucial role such as, *participatory dialogue* in which advantages of behavior change outweigh the disadvantages; or *behavioural confidence* where change in person's confidence to make a futuristic behavior modification emanates from self or outside sources; and *changes in the physical environment* that include availability and accessibility of tangible resources. Constructs of *emotional transformation* that include converting negative emotions into positive goals toward accomplishing positive behavior change, *practice for change* that involves constant thinking and rethinking about the behavior change and *changes in the social environment* which involves support from family, friends and other significant people in one's life are exceedingly vital for sustaining the behavior change [22].

The constructs of MTM for health behavior change have been extensively validated among a broad range of populations in cross-cultural settings [22]. Therefore, the aim of the present study was to predict physical behavior among upper elementary school children in a sample drawn from Northern India through Multi -Theory Model (MTM).

METHODS

Study design and procedure

The study was conducted in the Northern part of India in the city of Ambala. Ambala (area of 1,569 km^2) in the state of Haryana is located on the border with Punjab and in proximity to both states capital Chandigarh (47 kilometres from Ambala). Politically, Ambala is divided into two sub-areas: Ambala City and Ambala Cantonment (Ambala Cantt). Ambala has a population of around 11 lakhs as per the 2011 Census with 44.38% residing in urban and 55.62% in rural areas. The average literacy rate of Ambala is 81.75% [24].

A cross-sectional study design was utilized to test the applicability of Multi-Theory Model (MTM) of health behavior change in predicting initiation and sustenance of PA among elementary school-going children in the Indian context. The independent variables were the constructs of the multi-theory model (MTM) of health behavior change namely 'participatory dialogue', 'behavioural confidence', and 'changes in the physical environment' for the initiation model and 'emotional transformation', 'practice for change', and 'changes in the social environment' for the sustenance model.

For the initiation model, the dependent variable was the intention to engage in 60 minutes of physical activity every day. Whereas, for the sustenance model, the dependent variable was the intention to regularly engage in 60 minutes of physical activity every day from now on. The data were collected by using pretested and validated questionnaire designed to capture the information aboutinitiation and sustenance of physical activity behavior among upper elementary school-going children in district Ambala [25]. The questionnaire was adapted to the Indian context (Appendix-1).

Study participants and sampling

There are 235 schools in Ambala, of which 112 are government and 123 private. Geographically, 124 are in Ambala city and 111 in the Ambala cantonment area. In the present study, 10% of public and private schools were selected. With an expected proportion of obesity to be about 15 percent [17], the

estimated sample size was calculated using the formula of $N = 4Z_{\alpha}^{2} P (1 - P) \div W^2$. So, for an estimated 15% prevalence of obesity, with a desired 0.10 total width (W) of the confidence interval, and a 95% confidence interval, the estimated sample size was about 195. Considering a non-response rate of 10 percent, the sample size was increased to 214. The schooling system in Ambala district is a mix of urban and rural settings; government, government-aided private and fully private schools. The aim is to provide universal education to children irrespective of religion, caste, colour or creed. The population under study was children aged 9-12 years enrolled in the upper elementary classes of both government and private schools in Ambala district. Inclusion criteria were upper elementary school going children between 9-12 years, parents who provided consent for their children to participate in this study and children who gave assent to participate in this study. Children older than 12 years old or less than 9 years or with disabilities or other medical conditions and children who were already meeting 420 minutes of physical activity per week were excluded from the study.

Study instruments and measures

A 38-item PA questionnaire was used on PA and health behaviour research to assess the constructs of MTM (Appendix-1). This questionnaire was a Hindi translated version of a published version, which has an optimal face and content validity [25].

Ethical aspects

The project proposal was approved by the PGIMER Institute's Ethics Committee. The participants were explained about the purpose of the study. Informed parental consent and the child's assent were obtained from each participant before starting the interview process. Unnecessary and private inquiries were avoided while recording the responses. Privacy and confidentiality were ensured.

Data analysis

All data were analysed using SPSS, version 25.0. Descriptive statistical analyses were conducted to describe the study variables. Means and standard deviations for metric variables and frequencies and percentages for categorical variables were computed. Using stepwise multiple regression, significant predictors of PA behaviour change (i.e., initiation and sustenance) were assessed. Stepwise multiple regression analyses utilized 0.05 or lesser probability of the F to enter the predictor in the model and 0.10 or greater probability for removing the predictor from the model.

RESULTS

A total of 231 study participants completed the questionnaire to meet the desired sample size. Only 214 met the inclusion criteria out of 231 (92.6%), who reported less than 420 minutes of acquired PA in the past week and were included in the analysis. The mean age of the study participants was 10.51 ± 0.94 years. About 53.74% were boys and rest (46.26%) were girls. Details are shown in Table 1.

The mean for the intention to initiate engaging in 60 minutes of physical activity every day in the upcoming week was 2.14 units (*SD* = 1.23), whereas the mean for intended sustenance of regularly engaging in 60 minutes of physical activity every day from now on was 2.79 units (*SD* = 1.16). Additional descriptive statistics of MTM constructs are depicted in Table 2.

The results of the stepwise regression analyses are depicted in Table 3. The initiation model explained 12.5% variance in the intention to start PA behavior change, F (2,211) = 16.22, $P < 0.05$, Adjusted $R^2 = 0.125$. Behavioural confidence (β = 0.236, $P = 0.004$) and changes in the physical environment (β = 0.202, $P = 0.001$) were statistically significant predictors for the intention to initiate 60 minutes of PA every day in the upcoming week.

The results of the stepwise multiple regression for the sustenance model are depicted in Table 4. The model explained 5.3% of the variance in the intention for the sustenance of 60 minutes of PA every day from now (F(2,211)= 6.97, $P < 0.05$, Adjusted $R^2 = 0.053$). Emotional transformation (β = 0.169, $P = 0.012$)

and practice for change (β = 0.177, *P* = 0.008) were statistically significant predictors for the intention for the sustenance of 60 minutes of PA every day from now on.

DISCUSSION

The purpose of this study was to predict physical activity behavior among upper elementary school children in a sample drawn from Northern India using the multi-theory model (MTM) of health behavior change. The results of the study demonstrated that two MTM constructs, namely, behavioural confidence (β = 0.236, *P* = 0.004) and changes in the physical environment (β = 0.202, *P* = 0.001) were significant predictors for initiating physical activity among children with a fair predictive potential, as these accounted for 12.5% of the variance in the intent to start physical activity. Such a percentage, while on the lower side, is common in the domain of health behavior studies. Similar studies using the construct of self-efficacy, which is related to behavioral confidence in Indian children, have also shown somewhat similar predictability [17].

The predictability on the lower side could be due to the fact that while this construct is important, in the Indian context children at this age tend to listen more to the advice of their parents and their behaviors are largely shaped in this way. The other reason could be that these days children at this age are spending more time on the screen in front of a computer or a smartphone or other such devices and thus not finding enough time for PA. This potentially leads to lower confidence level to engage in PA at the expense of sacrificing time from these sedentary activities which are more gratifying. Based on this study, it can be recommended that building behavioral confidence is vital for promoting physical activity among children. The other construct in the initiation model that was statistically significant was the changes in the physical environment. This is similar to previous studies reported in the Indian context [20]. The availability of resources for PA, such as a playground or a park is essential in making children physically active. Playgrounds are commonly available in schools in India. Furthermore, there are neighborhood parks, and, recently there is mushrooming of physical activity gyms and wellness centers in urban areas. There is a need for enhancing the focus of these avenues for promoting PA among upper elementary school children. In the initiation model, the construct of the participatory dialogue was not found to be significant. With regard to participatory dialogue perhaps the children were not convinced that the advantages of being physically active were more than the disadvantages especially when compared to readily available sedentary alternatives of immediate emotional comfort without physically straining the body.

Examining the sustenance model, two constructs of emotional transformation (β = 0.169, *P* = 0.012) and practice for change (β = 0.177, *P* = 0.008) were significant predictors. Their contribution to predictability was rather less at 5.3%. The reasons for this could be that while these constructs are important, there are competing influences that shape the PA behavior among upper elementary school children in India. These include parental influence, academic pressure, peer influence, or the growing allure of sedentary activities that keep children away from making sustained efforts toward being physically active. Empirically, above stated factors are supported by a qualitative study of South Asian adolescents who mentioned academic pressures and preference for other sedentary recreational activities as barriers for participation in physical activity [26].

This study has important implications for designing interventions for upper elementary school children in India to promote physical activity. The behavioral confidence of children to overcome the immediate gratification of indulging in sedentary activities and making efforts to participate in PA proactively must be emphasized. For continued maintenance of physical activity behavior, use of technology based applications or other monitoring devices that bolster the MTM construct of practice for change must be utilized. Likewise, for building emotional transformation, it is

Table 1. Descriptive statistics of the study participants (*n* = 214).

		Mean ±SD	n (%)
Age (years)		10.51±0.94	214
Gender			
	Males	10.47±0.99	115 (53.74%)
	Females	10.55±0.88	99 (46.26%)

Table 2. Descriptive statistics of the constructs of MTM (*n* = 214).

Constructs	**Possible range**	**Observed range**	**Mean ±SD**
Initiation	0-4	0-4	2.14 ±1.23
Participatory dialogue: Advantages	0-20	2-20	12.58±3.38
Participatory dialogue: Disadvantages	0-20	0-18	9.71 ±3.31
Participatory dialogue: advantages – disadvantages score	-20 – +20	-8 – 20	2.87 ±4.44
Behavioral confidence	0-20	3-20	10.05±3.83
Changes in the physical environment	0-20	1-12	6.23 ±2.28
Sustenance	0-4	1-4	2.79±1.16
Emotional transformation	0-12	0-12	7.87 ±2.47
Practice for change	0-12	0-12	4.93±3.02
Changes in the social environment	0-12	1-12	7.05 ±2.31

Table 3. Parameter estimates based on stepwise regression analysis* to predict intention for initiation of physical activity behavior change using MTM constructs.

Variable	B	SE_B	β	**T**	**p-value**	**95%CI**
Behavioral confidence	0.065	0.022	0.236	2.91	0.004	0.020-0.108
Changes in the physical environment	0.128	0.037	0.202	3.41	0.001	0.054-0.201

F (2,211) = 16.22, P < 0.05, R^2 = 0.1333, Adjusted R^2 = 0. 1251

B = Unstandardized coefficient; SEB = Standard error; b = Standardized coefficient; t= Student's t-statistic; P-value=probability value; CI = Confidence Interval of unstandardized coefficient
* Stepwise regression removed the construct of participatory dialogue.

Table 4. Parameter estimates based on stepwise regression analysis* to predict intention for sustenance of physical activity behavior change using MTM constructs.

Variables	B	SE_B	b	T	***p*-value**	95% CI of B
Emotional transformation	0.798	0.031	0.169	2.54	0.012	0.017- 0.141
Practice for change	0.068	0.025	0.177	2.67	0.008	0.017- 0.119

F (2,211)= 6.97, P < 0.05, R^2 = 0.062, Adjusted R^2 = 0.053

B = Unstandardized coefficient; SEB = Standard error; β = Standardized coefficient;t=Student's t-statistic; *P*-value= probability value; 95% CI= 95% Confidence Interval of unstandardized coefficient. * Stepwise regression removed the construct of changes in the social environment

recommended that children should be taught to convert negative emotions into concrete PA goals, such as walking a prescribed number of steps daily or performing a targeted number of jumping jacks or other similar MVPAs'.

Study limitations and strengths

MTM framework can serve as a foundation on which other influencing constructs can be added to develop a precision intervention to offset the growing influence of sedentary activities among children. However, the study was not without limitations. The first limitation of the study was the use of a cross-sectional study design which precludes making inferences about causality as it lacks establishment of temporal sequence because information on both the independent and dependent variables is collected at the same time. However, previous empirical evidence with a longitudinal design suggests that the constructs of MTM precede the intent to perform the behavior so the limitation of using a cross-sectional design can be mitigated to some extent [27].

The second limitation is the use of self-report in collecting data. Self-reports are amenable to dishonesty, exaggeration especially among children at this age, recall bias, and other such shortcomings. However, in order to obtain information about attitudes which this study aimed at deciphering there is no other way than self-reporting. The third limitation of this study was that the researchers did not conduct construct validation, internal consistency reliability or test-retest reliability of the instrument. Perhaps future researchers can measure these aspects. Finally, the dependent variables in this study were intentions toward initiating and sustaining physical activity, which are essentially proxy measures of actual physical activity. Future research must utilize objective measurement of PA such as use of accelerometer and other tools.

CONCLUSION

It can be asserted from this study that MTM is a useful framework to design interventions to promote physical activity among upper elementary school children in India. More empirical work needs to be undertaken in India, using randomized controlled trials that operationalize expanded form of this model. This will facilitate robust designing, implementation and evaluation of PA interventions. With such efficacy trials, the growing public health threat of physical inactivity among school-going children can be addressed effectively.

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