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Physical Activity Indices in Patients with Type 2 Diabetes and Their Adult Children

Adeniyi A. F[1], Ogwumike O. O[1], Olasanoye O. T[1], Adeleye J. O[2]

[1]*Department of Physiotherapy, College of Medicine, University of Ibadan, Ibadan, Nigeria*

[2]*Department of Medicine, College of Medicine, University of Ibadan, Ibadan, Nigeria*

ABSTRACT

In the face of a rising diabetes epidemic, a target population for prevention programme is the children of patients with type 2 diabetes. This study examined physical activity of patients with type 2 diabetes and that of their adult children, and characterized the factors associated with physical inactivity among the participants. This cross-sectional study involved 315 participants (185 patients and 130 adult children) recruited from two major hospitals in Ibadan, Nigeria. Physical activity was assessed using the International Physical Activity Questionnaire and data were analysed using descriptive and inferential statistics at $\alpha = 0.05$. The prevalence of physical inactivity was 50.3% and 28.5% among parents and children respectively. Lack of awareness of physical activity benefits (OR = 2.11; 95% CI = 1.22-3.66) and ignorance of parent's diabetes status (OR = 3.21; 95% CI = 1.48-4.92) were both associated with increased risk of physical inactivity among the children. The risk was reduced by half among children of physically active parents (OR = 0.47; 95% CI = 0.16-0.89); while increasing age, female sex and unemployment were associated with increased risk of physical inactivity in both parents and children. Physical inactivity was more prevalent in parents than their children. Aside socio-demographic characteristics which influenced physical activity in both groups, lack of knowledge of physical activity benefits, ignorance of parent's diabetes status and physical inactivity of the parents were the factors that encouraged physical inactivity among the children. Educational efforts to step up physical activity among children of patients with type 2 diabetes are required.

Keywords: *Physical activity, Diabetes, Offsprings, Health promotion*

*Author for correspondence: *E-mail:* adeniyifatai@yahoo.co.uk; *Tel:* +234-8057325888

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INTRODUCTION

Type 2 diabetes mellitus is the commonest type of diabetes and as at the year 2015, it was reported to affect about 1.6 million persons in Nigeria with a prevalence of about 1.9% for persons between 20 and 79 years (IDF, 2016). It has become a health-care problem worldwide, with the rise in disease prevalence being more worrisome as it not only affects the developed world but also developing nations with fewer resources to cope with the burden (Barroso, 2005). Based on this growing trend of diabetes, there is therefore the need to step up activities towards primary prevention of diabetes especially among the high-risk populations. Although lifestyle and overeating seem to be the triggering pathogenic factors, genetic elements are also involved in the pathogenesis of type 2 diabetes (Stumvol *et al.*, 2005) and this may have put the children of patients with diabetes on a higher risk of developing the disorder. According to a previous study, an individual with a positive family history of diabetes has more than double the risk of developing type 2 diabetes (Perce *et al.*, 1995), and the incidence in the offsprings of diabetic couples is more than the incidence in the offsprings of whom only a single parent is diabetic (Kumar *et al.*, 2013).

For an offspring that presents with insulin resistance, reductions in mitochondrial content results in decreased mitochondrial function, which predisposes insulin resistant offsprings to intramyocellular lipid accumulation, which in turn activates a serine kinase cascade that leads to defects in insulin signaling and action in muscle (Morino *et al.*, 2005; Kumar *et al.*, 2013). Although genetics could have played some significant role in the aetiology of type 2 diabetes, there seems to be much more reasons why the children of patients with type 2 diabetes will go ahead to develop the disorder. According to a previous study, it was reported that although

genetic predisposition is important for the development of abnormal glucose tolerance, non-genetic factors, however, might play a predominant role in controlling whether genetically predisposed individual progresses to overt type 2 diabetes (Poulsen *et al.,* 1999). One of such non-genetic factors is the adoption of a physically inactive lifestyle.

The need to study the participation in physical activity of children of patients with type 2 diabetes is important because of the fact that the children have a higher risk of developing it and because physical activity has been shown to be helpful in the prevention of type 2 diabetes (Lindstrom et al., 2003; Laaksonen et al., 2005). According to Laaksonen et al., (2005), increasing physical activity can substantially reduce the incidence of type 2 diabetes in individuals that have the high risk of developing it. A lifestyle modification program with the goals of at least a 7 percent weight loss and at least 150 minutes of physical activity per week had been reported to reduce the incidence of diabetes by 58% and this was found to be more effective than metformin therapy (Knowler et al.,2006). However, according to a previous study carried out in the USA, the majority of patients with diabetes and those persons with high risk for developing type 2 diabetes do not engage in regular physical activity, with a rate significantly below national norms (Morrato et al., 2007). Despite the higher risk of children of at least a parent with diabetes, and based on the evidence on physical activity's ability to reduce the risk, it is not known to what extent the children of Nigerian patients with type 2 diabetes engage in physical activity programmes. In addition, this kind of data providing simultaneous information on the physical activity of patients with type 2 diabetes and their adult children is generally lacking. The current study investigated the physical activity level of patients with type 2 diabetes and that of their adult children; and also examined whether socio-demographic factors, physical activity of the parents and the knowledge of their parents' diabetic status will influence the physical activity of their children

METHODOLOGY

Participants: The participants in this cross-sectional study were 315 persons made up of 185 patients with type 2 diabetes and 130 of their adult children who volunteered to participate in this study within a data collection period of 6 months. Patients were those who met the inclusion criteria and attended the diabetes clinics of the University College Hospital and State Hospital Ring Road, both in Ibadan, Nigeria. They were expected to have been diagnosed with type 2 diabetes, have adult children that could be reached physically or through telephone and must be able to read and/or understand either of Yoruba or English language. Patients whose duration of diagnosis was less than six months and those with complications that may affect participation in physical activity e.g. blindness and amputation were excluded.

Instruments: The following data collection instruments were used:

International Physical Activity Questionnaire (IPAQ): The development of the IPAQ, an international measure for physical activity commenced in Geneva in 1998 and was followed by extensive reliability and validity testing undertaken across 12 countries (Craig *et al.,* 2003). The questionnaire is in two versions (long and short versions). The long version comprises of 5 activity domains asked independently) and the short version comprises 4 activity domains. Both versions are recommended for use by either telephone or self-administered methods (IPAQ Guidelines, 2005). The IPAQ short form (IPAQ-SF) was administered to the participants in this study. The IPAQ-SF has 7 items used in assessing physical activity undertaken across a comprehensive set of domains including: leisure-time physical activity, domestic and gardening (yard) activities, work-related physical activity, and transport-related physical activity. The IPAQ-SF asks about three specific types of activities covering areas of walking, moderate intensity activities and vigorous-intensity activities. It obtains details about the specific types of activities undertaken within each of the four domains (IPAQ Guidelines, 2005).

Test-retest reliability was determined to be around 0.8 for Spearman's rho when the retest was performed after 3 to 7 days, while the criterion validity was determined to be around 0.3 (Rho) when tested against accelerometer data from 7 consecutive days (Booth et al, 2003). Another study conducted by Oyeyemi *et al.* (2008) on test-retest reliability of IPAQ environmental module in an African population provides evidence on the psychometric properties of items on the measure of physical activity in a Nigerian population. The authors thus concluded that items on IPAQ are promising and useful for assessing physical activity among the black population in Africa (Oyeyemi *et al.,* 2008).

Scoring protocols for the IPAQ: The items in the IPAQ-SF were structured to provide separate scores on walking, moderate-intensity and vigorous-intensity activities as follows:

Walking MET (minutes/week) = 3.3 x walking minutes x walking days.

Moderate MET (minutes/week) = 4.0 x moderate intensity activity minutes x moderate intensity days.

Vigorous MET (minutes/week) = 8.0 x vigorous intensity minutes x vigorous intensity days.

A combined total physical activity MET-min/week was computed as the sum of Walking + Moderate + Vigorous MET-min/week scores. Scores are expressed in Metabolic Equivalent Tasks (MET) –minutes/week and are defined as: *Total physical activity MET (minutes/week) = sum of walking + moderate + vigorous MET (minutes/week) scores.*

Physical activity level was categorized into: vigorous (with a minimum of 1500 MET – minutes/week), moderate (with at least 600MET – minutes/week) and low (if activity was lower than 600 MET - minutes/week) (IPAQ Guidelines, 2005).

Procedure for Data Collection: Ethical approval of the University of Ibadan/ University College Hospital Ethics Review Committee (UI/EC/15/0232) was sought and obtained prior to the commencement of the study. An informed consent form stating the purpose of the study as well as assuring participants of confidentiality and anonymity was attached to the questionnaire administered. The IPAQ-SF was translated

through a forward-backward translation to Yoruba language for the benefit of Yoruba speaking participants who did not understand or speak English. Yoruba language was chosen because the research centres were located in a predominantly Yoruba speaking region of Nigeria. Questionnaires were distributed to the patients, while that of their adult children were also handed over to the parents who served as volunteer couriers for their children. For those whose children were out of reach (due to geographical or other reasons) within the data collection period, the parents provided their telephone numbers for the purpose of telephone administration. Such persons were called and interviewed on phone. The discrepancy in the number of parents and that of the children that participated in this study is explained by the fact that some of the children refused to take part in the study, especially those that had to be interviewed on phone. Additional data covering their sociodemographic characteristics such as age, sex, level of education, marital status and duration of diagnosis (for parents) were taken.

Statistical analysis

Data were summarized using the descriptive statistics of frequency distribution and percentages. Multiple regression analysis was used to analyse how characteristics of both the patients and their children were associated with low physical activity. All analyses were carried out using IBM SPSS version 20 statistics for Windows (SPSS Inc., Chicago, IL, USA) at $\alpha = 0.05$.

Table 1:
Sociodemographic characteristics of the participants (parents and children)

Parents (n = 185)		**Children (n = 130)**	
Parent characteristic	**n (%)**	**Children characteristic**	**n (%)**
Age group (years)		**Age group (years)**	
<30	--	<30	31 (23.8)
30-39	6 (3.2)	30.39	43 (33.1)
40-49	21 (11.4)	40-49	33 (25.4)
50-59	44 (23.8)	50-59	23 (17.7)
60-69	68 (36.8)	60-69	--
≥70	46 (24.9)	≥70	--
Sex		**Sex**	
Male	56 (30.3)	Male	55 (42.3)
Female	129(69.7)	Female	75 (57.7)
Employment		**Employment**	
Unemployed	19 (10.3)	Unemployed	16 (12.3)
Employed	98 (53.0)	Employed	113 (86.9)
Retired	68 (36.7	Retired	1 (0.8)
Level of education		**Level of education**	
Nil	35 (18.9)	Nil	1 (0.8)
Primary	57 (30.8)	Primary	15 (11.5)
Secondary	46 (24.9)	Secondary	42 (32.3)
Tertiary	47 (25.4)	Tertiary	72 (55.4)
Marital status		**Marital status**	
Single	2 (1.1)	Single	42 (32.3)
Married	134 (72.4)	Married	84 (64.6)
Widowed	47 (25.4)	Widowed	4 (3.1)
Divorced	2 (1.1)	Divorced	--
Duration of diagnosis (years)		**Duration of diagnosis (years)**	
<10	110 (59.5)	<10	3 (2.3)
10-19	55 (29.7)	10-19	--
20-29	12 (6.5)	20-29	--
30-39	7 (3.8)	30-39	--
≥40	1 (0.5)	≥40	--

RESULTS

The sociodemographic characteristics of the participants are presented in Table 1. The table contains details of their age, sex, employment, marital status, level of education and duration of diagnosis of diabetes. The table shows that the highest proportion of parents (n = 68, 36.8%) were in the age range of 60-69 years while the highest proportion of the children (n = 43; 33.1%) were in the age group of 30-39 years.

Figure 1 contains characteristics that were exclusive to the children. The data includes whether the children were diagnosed with diabetes or not, whether they were aware of their parents' diabetic status, and if they were aware of the role of physical activity in the prevention and control of diabetes. The figure shows that most of them (n = 118; 90.8%) were aware that at least one of their parents was diabetic. The physical activity levels of the participants are presented in figure 2.

The figure shows that half (50.3%) of the parents reported low physical activity as against 28.5% of their children that reported low activity. Almost equal proportion (42.2% and 55.4%) of the parents and children presented with moderate physical activity level respectively.

Table 2 contains the results of the multiple regression analyses showing which participants' characteristics were associated with low physical activity level. The table shows that older age is associated with an increased risk of low physical activity among both the parents and the children. Parents who were aged 60-69 years (OR = 2.88; 95% CI = 1.03-4.12) and ≥ 70 (OR = 3.45; 95 CI = 2.11-4.84); and children who were aged 50-59 years (OR = 2.87; 95 CI = 1.76-3.86) were at higher risk of low physical activity compared to their younger counterparts.

For both groups, female sex was associated with increased risk of low physical activity while being employed was associated with a reduced risk. Specifically however, compared to those diagnosed less than10 years ago, being diagnosed of diabetes for 10 years and over was associated with an elevated risk of low physical activity (OR = 2.26; 95% CI = 1.15-3.45) among the parents. Among the children, lack of awareness about benefits of physical activity (OR = 2.11; 95% CI = 1.22-3.66) and ignorance of parents' diabetes status (OR = 3.21; 95% CI = 1.48-4.92) were both associated respectively with doubled and tripled risk of low physical activity. The risk was reduced by half among children of physically active parents (OR = 0.47; 95% CI = 0.16-0.89)

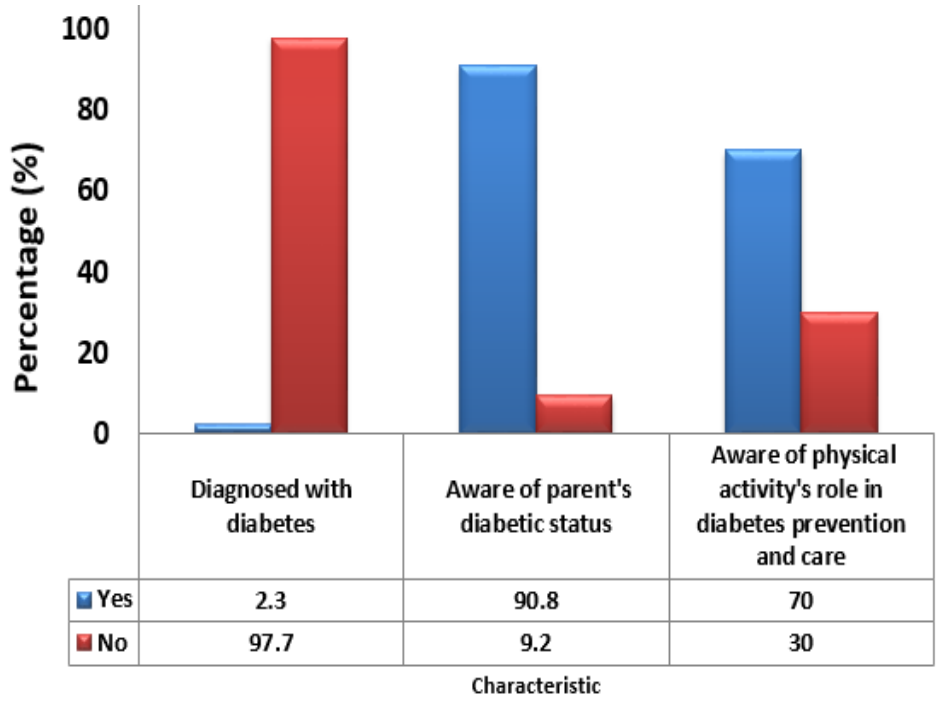

Fig. 1:
Additional characteristics of the children

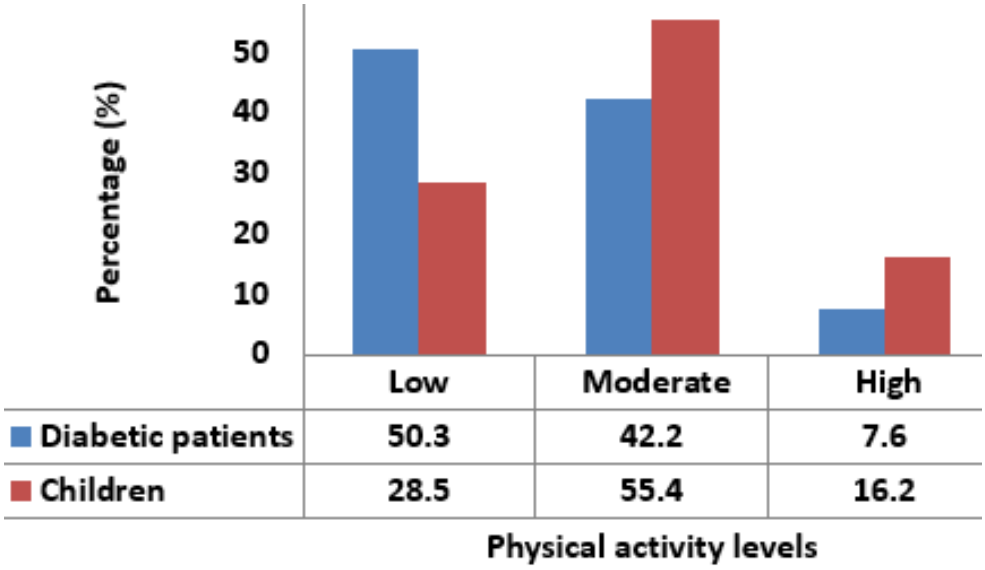

Fig. 2:
Physical activity level of participants (patients with type 2 diabetes and their children)

DISCUSSION

This study was conducted to investigate the physical activity of patients with type 2 diabetes and that of their adult children, and to investigate what factors contribute to physical inactivity among both groups. It was observed that 1) about half of the patients and about one third of their children reported low physical activity levels, 2) close to one third of the children were not aware that physical activity was relevant in the prevention and control of diabetes mellitus, 3) lack of awareness of parents' diabetes status, and lack of awareness about relevance of physical activity in the prevention and control of diabetes were linked with increased risk of physical inactivity while having patents who were physically active was linked to a reduced risk of physical inactivity among the children.

The somewhat high prevalence of physical inactivity among the participants in this study is not an entirely new

finding. The topic of physical activity among the general population and particularly among the population of people with diabetes has enjoyed a wide documentation from around the globe (King *et al.*, 2000; Hallal *et al.*, 2003; Bauman *et al.*, 2009). Among the Brazilian population, the prevalence of physical inactivity was reported as 41.1% (Hallal *et al.*, 2003), it was in the range of 7 to 41% in a multinational study involving 20 countries (Bauman *et al.*, 2009), while a review study reported a prevalence of 25-57% for a Nigerian population (Abubakari and Bhopal 2008). Specifically among Nigerian patients with type 2 diabetes, Adeniyi *et al.* (2010) reported a prevalence of 27.4% for physical inactivity. There is no singular reason proffered for the physical inactivity of patients with type 2 diabetes or the general population of which the offspring of the patients with type 2 diabetes belong. However, depending on the population that is being studied, reasons such as lack of expert advice about physical activity (Adeniyi *et al.*, 2010), perceived difficulty taking part in exercise, feelings of tiredness, being distracted by something good on television, lack of time and lack of facilities have been reported (Thomas *et al.*, 2004).

Table 2:
Predictors of low physical activity by sociodemographic and clinical characteristics of participants (parents and their children)

Parents		Children	
Patient Characteristics	**Low physical activity OR (95% CI)**	**Children characteristics**	**Low physical activity OR (95% CI)**
Age (years)		**Age (years)**	
30-39	1	<30	1
40-49	1.64 (0.43-2.45)	30.39	0.61 (0.32-1.46)
50-59	1.79 (0.53-2.58)	40-49	1.33 (0.88-1.95)
60-69	2.88 (1.03-4.12)*	50-59	2.87 (1.76-3.86)*
≥70	3.45 (2.11-4.84)*	≥70	----
Sex		**Sex**	
Male	1	Male	1
Female	3.12 (2.10-4.28)*	Female	2.1.4 (1.17-4.56)*
Level of education		**Level of education**	
Nil	1	Nil	----
Primary	0.74 (0.45-1.62)	Primary	1
Secondary	0.55 (0.21-1.04)	Secondary	0.82 (0.44-1.51)
Tertiary	1.39 (0.71-2.54)	Tertiary	0.67 (0.24-1.77)
Employment		**Employment**	
Unemployed	1	Unemployed	1
Employed	0.81 (0.56-1.83)	Employed	0.51 (0.31-0.79)*
Retired	3.33 (1.89-5.68)*	Retired	----
Marital status		**Marital status**	
Married	1	Married	1
Widowed	1.03 (0.26-1.58)	Widowed	----
Single/Divorced	1.52 (0.74-2.16)	Single	0.43 (0.12-1.03)
Duration of diagnosis		**Aware of parents diabetes status**	
<10	1	Yes	1
≥ 10	2.26 (1.15-3.45)*	No	3.21 (1.48-4.92)*
		Aware of benefits of physical activity in prevention and control of diabetes	
		Yes	1
		No	2.11 (1.22-3.66)*
		Physical activity of parents	
		Low	1
		Moderate-to-high	0.47 (0.16-0.89)*

About 1 out of every 3 of the children in the present study was not aware that physical activity plays an important role in the prevention and control of diabetes. While the present study records a low number of the children having awareness of physical activity, a similar finding in the USA went further by also reporting that only a third of respondents were accurately knowledgeable of the Center for Diseases Control and Prevention/American College of Sports Medicine's physical activity recommendations (Bennet et al., 2009). In view of this finding, using simple logic, it can be extrapolated that persons who are not familiar with the benefits inherent in any action are unlikely to imbibe such actions. This scenario might have played a significant role in the substantial number of the children who reported low physical activity levels. A study by Haase et al. (2004) among a cross-section of university students from 23 countries showed that the prevalence of inactivity in leisure time varied with cultural and economic developmental factors, averaging 23% (North-Western Europe and the United States), 30% (Central and Eastern Europe), 39% (Mediterranean), 42% (Pacific Asian), and 44% (developing countries). The authors further reported that the relationship between health beliefs and behaviour is robust across cultures, but importantly, health knowledge remains deficient among the population.

While up to two-third of the children were aware of the role of physical activity in the prevention of diabetes, up to 9 out of every 10 of the children were also aware that at least one of their parent was living with diabetes mellitus. The awareness of the benefits of physical activity combined with the awareness that their parents were living with diabetes was expected to have translated into more physical activity for the children, yet up to a third of them were inactive. That notwithstanding, the proportion of physical inactivity reported by the children was far less than that of their parents. This may be because the children were much younger with most of them still in gainful employment. Regression analyses of the current findings showed that increasing age, being female, and being unemployed were associated with an increased risk of reporting physical inactivity and these are similar to what was obtained in previous findings (Hallal et al., 2003; Wanko et al., 2004; Abubakari et al., 2009; Bauman et al., 2009). Lack of awareness about benefit of physical activity and not knowing that parents were diabetic were also associated with an increased risk of reporting physical inactivity in the present study.

It was however interesting but not surprising to note that children of physically active patients reported a reduced risk of physical inactivity. Although the study by Moore et al. (1991) was among children 4-7 years, it was found that when both parents were physically active, the children were 5.8 times as likely to be active compared to children of inactive parents. The mechanisms for the relationship between parent and child activity levels include the parents serving as role models, sharing of activities by family members, enhancement and support by active parents of their child's participation in physical activity, and genetically transmitted factors that predispose the child to increased levels of physical activity (Moore et al., 1991; Anderssen and Wold 1992). However, a previous study had reported a slightly different observation indicating that parental physical activity is not transmitted to their children to the degree that is often believed (Anderssen et al., 2006).

Considering the need to prevent or delay the onset of diabetes among individuals with high risk of developing it, this study is pertinent because it is able to provide a side-by-side data of physical activity among patients with type 2 diabetes and their adult children. This information, although very relevant to the health promotion campaign is not readily available in the literature and it is probably the first study to analyze physical activity among these two closely related populations in Nigeria. The importance of this study notwithstanding, a few limitations featured and they are worthy of being mentioned. Although the methods used in data collection were standard procedures, it is important to note that the study was cross-sectional; hence possibility of recall bias could not be underrated. In addition, it is important to note that although only a minute fraction of the children reported being diagnosed with type 2 diabetes, this does not necessarily reflect the accurate details of their diabetes status as we did not investigate how many of them actually undertook a screening for diabetes and how long ago did they undergo their last screening.

In conclusion, the type 2 diabetes patients and their children differed in their physical activity levels, with the prevalence of physical inactivity being higher among the parents compared to their adult children. However, both groups were similar in respect of some factors associated with physical inactivity, as it was observed that increasing age, being a female and being unemployed were associated with physical inactivity among the parents and their children. For the children, those who reported lack of awareness about their parents' diabetes status and about the benefits of physical activity in the prevention of diabetes reported higher risks of physical inactivity, but those with physically active parents reported lower risk of physical inactivity. Efforts are required to step up physical activity education as a form of primary prevention of diabetes among children of patients with type 2 diabetes.

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