**The impact of free access to swimming pools on children's participation in swimming. A comparative regression discontinuity study.**

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**ABSTRACT**

**Objective.** Investigating the extent to which providing children with free swimming access during school holidays increased participation in swimming and whether this effect differed according to the socioeconomic deprivation of the neighbourhoods in which children lived.

**Setting:** A highly disadvantaged local authority (LA) in North West England.

**Intervention:** Provision of children with free swimming during the summer holidays.

**Outcome measures:** Number of children swimming, and the number of swims, per 100 population in 2014.

**Design**. Comparative regression discontinuity investigating the extent to which participation rates amongst children aged 5-15 were greater in the intervention LA compared to a similar control LA. We estimated the differential effect of the intervention across five groups, defined by quintiles of area deprivation.

**Results.** Free swimming during the summer holidays was associated with an additional 6% of children swimming (95% CI 4% to 9%) and an additional 33 swims per 100 children per year (95% CI 21 to 44). The effects were greatest in areas with intermediate levels of deprivation (quintiles 3 and 4) within this deprived LA.

**Conclusion.** Providing free facilities for children in disadvantaged areas is likely to increase swimming participation and may help reduce inequalities in physical activity.

**Key words:** Physical activity, policy, inequalities, leisure, pricing

**Word count: 3045.**

## BACKGROUND

Since the 19th century local authorities in the UK have been providing subsidised baths or swimming pools for public use. (1) The social benefits of these facilities, including social inclusion, community wellbeing and public health have often been used to justify this subsidy. (2) Whilst initially the introduction of public baths was seen as a way of improving public cleanliness, today they are increasingly seen as assets for promoting physical activity.(1) A lack of physical activity is a major public health concern as one in every three children in England is obese by the time they are 10 years old. (3) Children in the most deprived parts of the country are twice as likely to be obese and these inequalities are increasing. (3) Levels of physical activity amongst children in the UK are low with only 16% of girls and 21% of boys achieving the recommended level (3). The relationship between children's physical activity and levels of deprivation is less clear, with some studies showing lower levels in more disadvantaged groups and others showing no relationship with deprivation.(4–7) Increasing physical activity amongst children from deprived neighbourhoods is however an important strategy for addressing health inequalities.

Many local authorities, therefore, use public money to ensure the cost of using swimming pools is affordable, often providing free or concessionary rates for children. With increasing cuts to local government budgets, these schemes are at risk. Between 2009 and 2014 the public subsidy for local authority leisure facilities was cut by 32% from £550 million to £375 million.(8) Many councils are now seeking to pass on the full cost of providing leisure services to the users, removing subsidies altogether - ending the historic public investment in these facilities for social benefit.(9)

Between March 2009 and July 2010 the UK government subsidised free swimming for all children across the country. This scheme was ended early as part of the government's austerity package to reduce public spending.(10) Some councils, however, continued to provide free swimming for children. Analysis of uptake of the scheme in Bristol found no relationship between area deprivation and uptake of the offer, but larger distances to facilities and the winter season were both associated with lower participation in deprived areas. (11) Many local authorities are also considering whether to invest their public health budgets in subsidising leisure facilities. There is, however, limited evidence indicating the extent to which free swimming schemes increase participation, and whether this effect differs between socioeconomic groups. The limited robust evidence reflects the difficulty of investigating the impact of public health interventions that are applied universally across populations and as such are not amenable to traditional trial methodologies.

We therefore used a quasi-experimental approach – comparative regression discontinuity - to estimate the impact on participation in swimming of a free offer for children in one of the most deprived local authority areas in England and investigated whether this had a differential effect between socioeconomic groups within that local authority.

## METHODS

### Setting.

Blackpool is a deprived local authority in the North West of England with a population of 142,065 in the 2011 census. In 2015 it was ranked as the 4th most deprived area out of all 326 lower tier local authorities in England.

**The intervention.**

Blackpool Borough Council provides free use of its two swimming pools for children under 16 years old during the school holidays. The council has funded this free offer since 2010 when the national free swimming scheme for children ended. We investigated the impact of this free offer to children in Blackpool in 2014.

**Comparator.**

The comparison area used in this study was a similar local authority in the North West of England which ended its free swimming offer to children when the national programme ceased in July 2010. There was no free access to swimming pools for children in the comparison local authority in 2014. The population served by the comparison local authority is similar to Blackpool in terms of deprivation and the age and ethnicity of the population (see Table 1), whilst there were more swimming pools in the comparison local authority the average distance people had to travel to their nearest swimming pool was similar (Table 1).

**Table 1. Key information on deprivation, demography and leisure facilities for Blackpool and the comparison local authority**

| | Blackpool | Comparison local authority |
|---|---|---|
| Indices of Multiple Deprivation 2015 | 42 | 41 |
| % from black and ethnic minority groups | 3% | 3% |
| % population under 16 | 18% | 18% |
| Number local authority leisure facilities with swimming pools | 2 | 4 |
| Average distance (KM) to a swimming pool. | 1.6 | 1.6 |

**Dataset, outcomes and variables.**

We extracted data from the leisure management IT system for Blackpool and the comparison local authority for every attendance at local authority swimming pools in 2014 for all people aged between 5 and 40 years of age. Data included the type of activity (i.e. swimming), the date and time of the attendance, any cost associated with the attendance, an anonymised person identifier and their age, sex and postcode of residence. To access swimming pools in both of the local authorities, residents – including children - are issued with a personal swipe card and data is automatically recorded on the leisure management system when they attend for a swim. Both local authorities used the same leisure management IT system (Gladstone MRM). Postcode data were linked to data on the Indices of Multiple Deprivation (IMD)(12) using the Lower Super Output Area (LSOA) of residence. The Indices of Multiple Deprivation are a combined measure of the average population and environmental characteristics of areas based on 37 separate indicators, organised across seven distinct domains (income, employment, education, environment, health, crime and housing).(12) LSOAs are small geographical areas with a population of about 1500, used for the publication of

various area-based statistics by the Office for National Statistics (ONS). We categorised the IMD score into five groups (quintiles) of equal population size within the two study local authorities. All the LSOAs in the study local authorities were within the 70% most deprived areas nationally, and the most deprived 20% of LSOAs (quintile 5), were all within the most deprived 2% of areas in the country.

We calculated two outcomes. Firstly, rates of people swimming were calculated for single year age groups within each deprivation group for the two local authorities as the number of people swimming at least once in the year per 100 population, using 2014 population estimates from the ONS. Secondly swimming attendance rates were calculated as the number of swims per 100 population. We calculated these rates using data covering the whole year (1st January – 31st December 2014) and not just the school holidays, because it is possible that the free offer in school holidays resulted in displacement of activity from term time to the holidays. By including data from the whole year we account for any displacement in calculating the overall effect of the intervention.

**Analysis.**

Regression discontinuity (RD) is widely used to produce causal estimates, where a Randomised Controlled Trial (RCT) is not possible. RD designs have been shown to produce valid estimates when compared to RCTs (13,14), and there is growing evidence of its applicability for public health research across diverse settings (15). RD analysis is used when exposure to an intervention is based on a cut-off point on some continuous measure – referred to as the assignment variable. In the case of the free swimming intervention in this study, the assignment variable is age and the cut-off is 16. RD methods are then used to compare how outcomes vary between those just above and just below this threshold. Conditional on the relationship between the assignment variable and the outcome, exposure to the policy at the cut-off point is as good as random.(16) RD however has a number of weaknesses, including low statistical power and the need to accurately specify the functional form that describes the relationship between the assignment variable (age in our case) and the outcome in the absence of the intervention. The estimates from RD are also only valid for people just above or below the threshold and may not be generalizable to other groups. To mitigate these three weaknesses we use the Comparative RD(CRD) approach proposed by Wing and Cook(17) . This involves comparing the discontinuity within the intervention population (Blackpool) with the variation in the outcome across the assignment variable in a similar population not exposed to the intervention. Unlike in RD, using CRD we can estimate how swimming participation in children is likely to vary with age in the absence of the intervention by using the data from the comparison local authority. This provides an estimate of effect over all ages from 5 to 15, not just at the 15 year old threshold as in an RD design. The CRD provides greater statistical power, than an RD design as it includes data form both and intervention and comparison population – effectively increasing the sample size.

Firstly we estimated how each of our outcomes varied with age amongst those not exposed to the intervention (people 16-40 in Blackpool and all people aged 5-40 in the comparison local authority) for each deprivation quintile, using a local polynomial function. We then estimated a local polynomial regression of our outcomes on age for the group exposed to the intervention – children aged between 5 and 15 in Blackpool, for each deprivation quintile. The age specific effects of the intervention were then calculated as the difference between the predicted values of the outcomes

for those exposed and the predicted value if they were not exposed, accounting for the average difference in outcomes across all ages between Blackpool and the comparison local authority. We additionally controlled for the average distance to the nearest swimming pool for each age group and deprivation quintile within each local authority. Average treatment effects among all children aged 5-15 were then calculated as the weighted average of these age specific differences based on the population at each year of age (Full formulae are provided for the analysis in web Appendix 1).

The main assumption underlying this analysis is that in the absence of the intervention the outcomes in Blackpool and the comparison local authority would vary by an approximately constant amount across all ages – in other words the functional forms relating age to each outcome in the two local authorities would be parallel. This is equivalent to the parallel trends assumptions of difference-in-difference study designs.(18) We are assuming that there are unobserved factors that differ between Blackpool and the comparison LA that affect participation across all age groups from 5 to 40, for example the ethnic composition of the population, levels of disability, neighbourhood characteristics or the quality of local authority swimming facilities. By accounting for the average difference in overall swimming participation levels between Blackpool and the comparison local authority these unobserved factors are adjusted for in the analysis. We test whether this 'parallel trends assumption' is reasonable in additional analysis in web appendix 2.

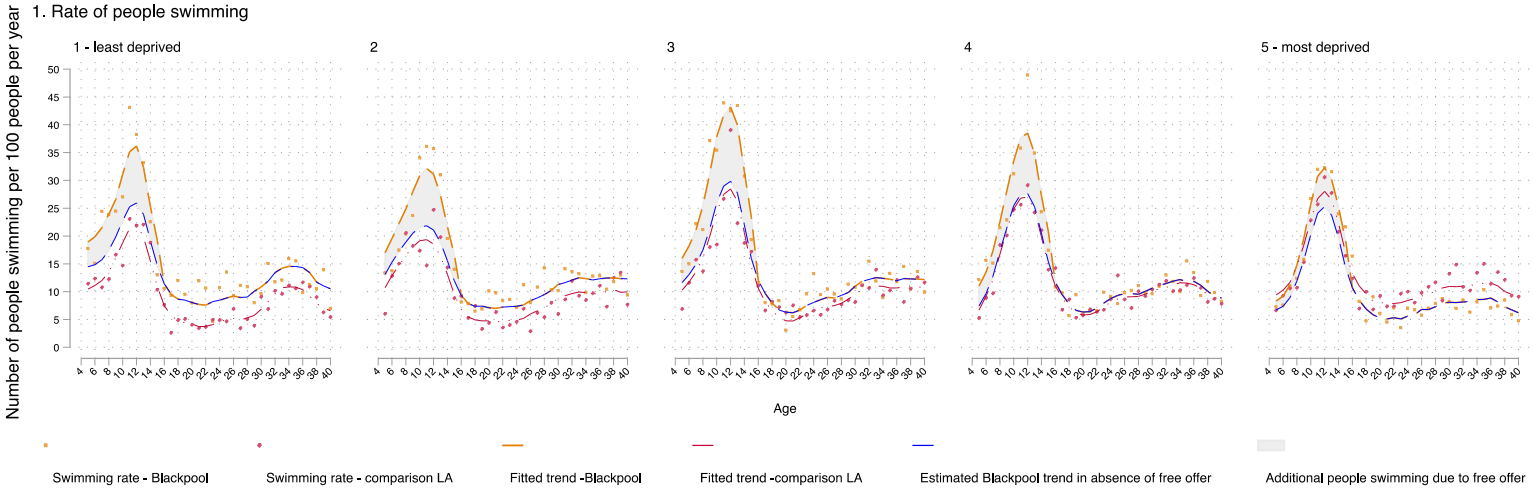
In a robustness test we also investigated whether there were spillover effects on age groups over 15. These could occur, for example, where the intervention encouraged other older people to swim more frequently, for example older friends, siblings or parents attending to accompany children under 16. This was checked by setting the cut-off point at each age from 5 to 40 years old and estimating the difference between the actual and expected outcomes at each age. (see web appendix 2).

**RESULTS**

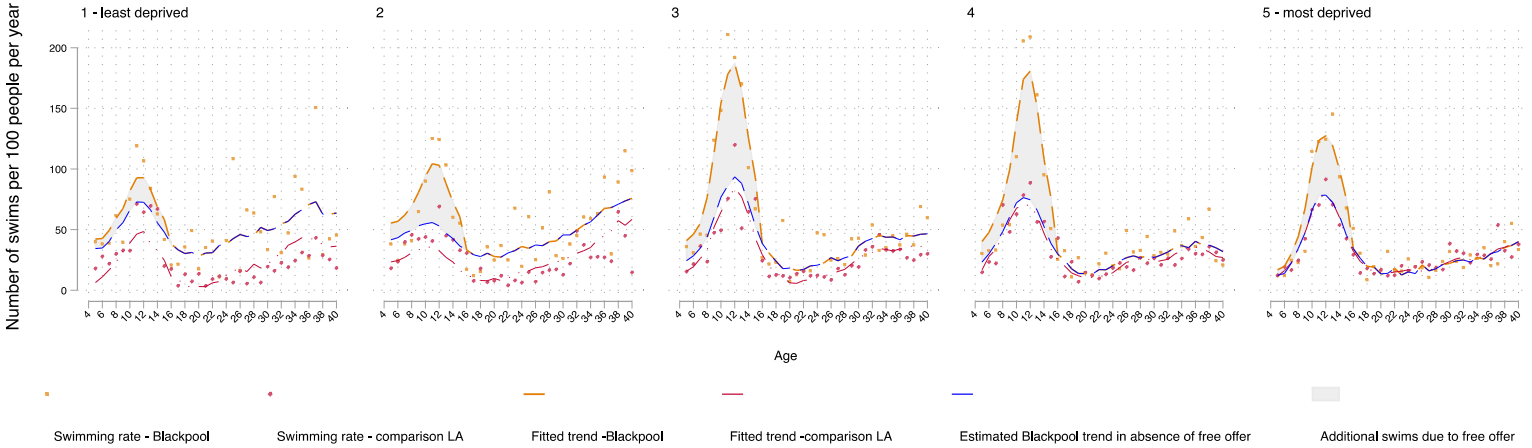
Figure 1 shows swimming attendance rate and the rate of people swimming in 2014 by single year of age in Blackpool and the comparison local authority for each deprivation quintile and the fitted values from the local polynomial regressions. The blue dashed line indicates the trend in Blackpool that would be expected in the absence of the intervention. The grey area indicates the effect of the intervention – the difference between the observed and expected levels.

**Figure 1. Swimming attendance rate and rate of people swimming (i.e. rate of unique swimmers) by single year of age and deprivation quintile for 5-40 year olds, in Blackpool and in the comparison local authority in 2014. Fitted lines derived from local polynomial regressions.**

1. Rate of people swimming




2. Swimming attendance rate




1

The rate of people swimming and the swimming attendance rate for those aged 16 and over was similar in Blackpool as in the comparison LA. Although the difference between the rates in Blackpool and the comparisons local authority varied between deprivation groups, within these groups the difference was approximately constant between the ages of 16 and 40 years old. We tested this formally in web appendix 2 and find that the there is no significant deviation from the parallel trends assumption for these ages. The rates increase for children under the age of 16 in both local authorities, however this increase is greater in Blackpool than in the comparison local authority. The extent to which the rates in Blackpool were higher than the expected levels, was greatest in quintiles 3-4.

**Figure 2. Estimated impact of the free swimming offer in Blackpool on the additional children swimming and the additional swims per 100 population.**

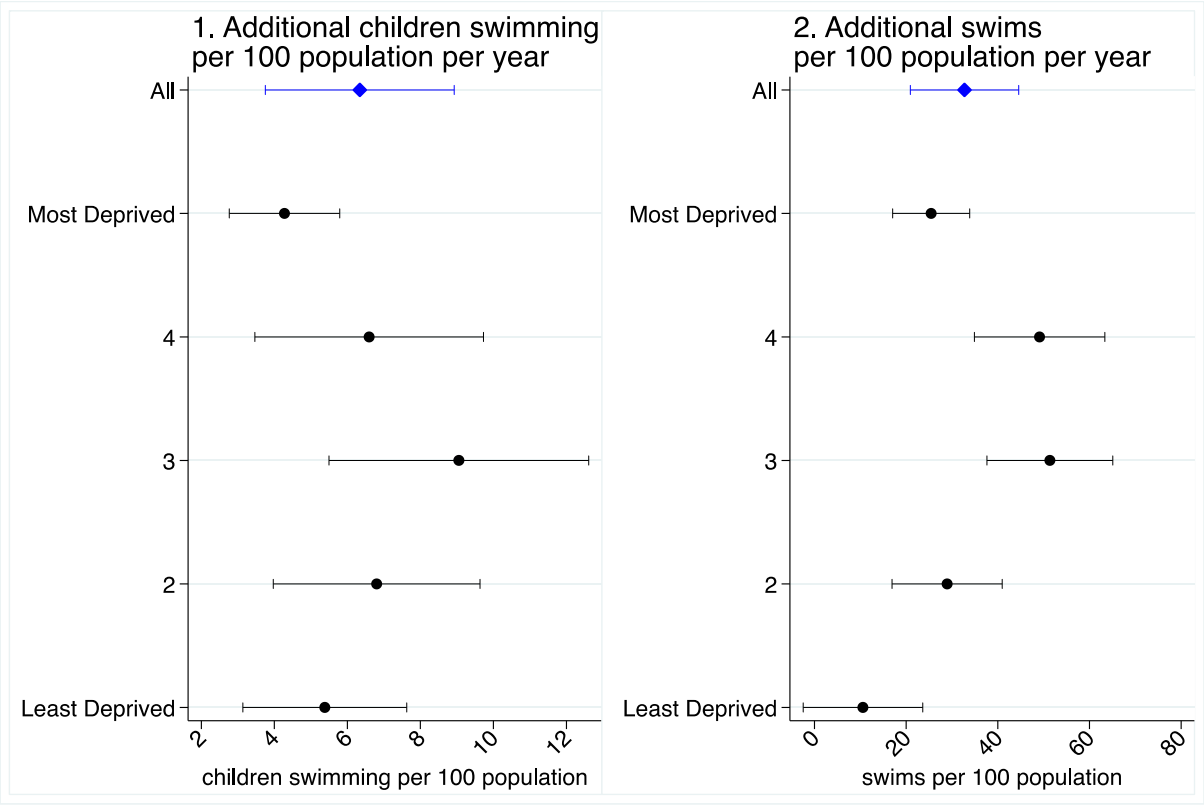



Figure 2 shows the estimates of the effect of the free-swimming offer from the comparative regression discontinuity model. Overall the free swimming offer was associated with an additional 6 children swimming per 100 children per year (95% CI 4 to 9). There was no significant difference in this outcome across deprivation quintiles, although the effect was greatest in quintile 3. Overall the free-swimming offer was associated with an additional 33 swims per 100 population per year (95% CI 21 to 44). This rate was higher in quintiles 3 and 4, but lower in the most and least deprived areas of Blackpool. In terms of the number of additional swims the effect in the least deprived areas was not statistically significant at the 5% level.

Investigation of spillover effects across older age groups indicate that there was no evidence that the intervention was increasing the swimming participation of people older than 16. The effects of the intervention were greatest amongst children aged 10-14 years old.

## DISCUSSION

### Main findings of this study

We found that offering free-swimming during the school holidays to children living in a very deprived local authority area was associated with an increase in participation in swimming. The effect was greatest amongst children living in areas that were moderately deprived compared to the rest of the borough, but was less pronounced in the least and most deprived parts of the borough.

### What is already known on this topic

The evaluation of the national free swimming initiative in the UK estimated that it led to an additional one swimmer and 44 swims per 100 children in the first year. This analysis was however based on hypothetical questions in an online survey – asking people about what they would have done in the absence of free swimming.(19) Such approaches are likely to have a high risk of bias and may not reflect people's actual behaviour change when entrance charges were removed. Studies and reviews comparing swimming rates for children before and after the introduction of free offers have reported larges increases in participation, with a particular increase during school holidays(20–22). However, these and other similar process evaluations provide limited evidence of the causal effect of free swimming initiatives.(23,24).

### What this study adds

Our findings suggest that removing the cost of swimming for children is effective in a very deprived local authority, leading to an additional 6% of children swimming. These estimates are greater than those reported in the evaluation of the national free swimming programme (an additional 1% of children swimming as a result of the free offer). There are a number of potential reasons for this difference. As outlined above the estimates from the national programme evaluation may not reflect the causal impact of introducing free swimming for children. Also the national programme evaluation only looked at average effects across the country. We found smaller effects in the least deprived areas in Blackpool. These areas have a level of deprivation that is equal to the average for England. It is therefore plausible that the effect of free swimming is greater in a more deprived area than the average effect of a free swimming offer across the whole country.

We found that the effect of free swimming was greatest amongst children living in parts of Blackpool that were moderately deprived compared to the rest of the borough (quintiles 3 and 4), whilst effects were smaller in the most deprived areas (quintile 5). Quintiles 3 and 4 in Blackpool are within the bottom 25% most deprived areas in the country. Although the effects were smaller in quintile 5, they still indicate that an additional 4% of children from these areas participated in swimming because of the free-swimming offer. This in itself could be seen as a relatively large effect given that the 20% most deprived neighbourhoods in Blackpool are extremely deprived – within the bottom 2% of areas nationally. Many residents in these areas will experience multiple forms of deprivation - for example 50% are living in poverty, 30% have a disability, 40% are living in poor housing and 55% of the working age population are out of work. (12) Given the multiple issues surrounding some

families in these very deprived areas it is perhaps not surprising that the free swimming offer had a smaller effect on participation in these areas. Whilst many interventions to promote physical activity are less effective in more disadvantaged populations, (25) our study indicates that providing children with free access to swimming facilities can increase swimming participation in deprived areas.

**Strengths and imitations of this study**

Our study has a number of strengths. Firstly we were able to utilise a robust quasi-experimental design that is likely to provide causal estimates of the effect of the intervention. Secondly by extracting administrative data we obtained data on participation in swimming at local authority facilities for the whole population in the two local authorities included in this study. We therefore did not need to rely on survey data from a population sample, which would be affected by sampling error and response bias. Thirdly by analysing the data by levels of area deprivation we were able to investigate the differential effects of the intervention on different socioeconomic groups.

Our findings, however, need to be understood in the context of several limitations. Firstly, it is not possible to determine whether the study outcomes reflect a clinically relevant increase in physical activity. It is possible that the increased participation in swimming reflected displacement from other physical activity. In other words, if the free swimming offer induced some children to switch from other physical activity to swimming, this will have limited the impact of the intervention on overall levels of physical activity. Conversely children who were encouraged to do more swimming because of the free offer may have also been encouraged to take up other forms of physical activity. The study outcomes would then have underestimated the overall effects on physical activity. Secondly, administrative data can be subject to errors. Although in the two study local authorities swipe cards are used to access the swimming pools it is likely that some access occurs without it being recorded on the administrative system and details such as age may be incorrectly recorded. It is likely however that these errors will be approximately random. Thirdly, we relied on an area-based indicator of socioeconomic status, which may not necessarily reflect the socioeconomic status of people living in these areas. As we are investigating the average effects across deprivation groups, however, it is only necessary that the area based measures reflect average levels of socioeconomic status within those areas. Nevertheless, bias could result if there was an interaction between deprivation group and individual measures of socioeconomic status –although there are no reasons to think this would be the case. Fourthly, as with any observational study it is possible that unmeasured confounders could bias the results. In part this issue is addressed by the study design which accounts for any unmeasured confounder which affects participation across all ages from 5 to 40 years old. Other unmeasured confounders could however still bias the results if they have a different effect on children's levels of swimming participation than on adult swimming participation and were more common in Blackpool than the comparator area. There are however no obvious factors that meet these conditions.

**Conclusion**.

Local authorities in the UK are facing severe cuts to their budgets. Since 2013, however, they have been granted greater responsibilities for promoting public health and reducing health inequalities.

They are therefore having to make difficult decisions about the targeting of resources to those interventions that are likely to have an impact. This study shows that providing free access to swimming facilities to children living in a deprived local authority can increase swimming participation and may help promote physical activity amongst children in these areas, helping to reduce inequalities in child health.

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**Ethics**

Ethics approval was not required.

**What is already known on this subject**

Physical inactivity is a public health concern, with one in three children classed as obese by age 10. This rate is higher in children from deprived areas, and increasing physical activity in children from deprived backgrounds is a means of addressing these health inequalities. Many local authorities offer free access to swimming facilities for children, however the extent to which this increases participation is not known, nor whether effects differ according to the socioeconomic deprivation of the neighbourhoods in which children live.

**What this study adds.**

Using a robust quasi-experimental method we found that providing free access to swimming facilities in Blackpool for under 16's during school holidays increased participation in this very deprived local authority. The effect was greatest in areas with intermediate levels of deprivation (quintiles 3 and 4) within this deprived LA. The study indicates that providing free access to swimming facilities to children living in a deprived local authority can increase swimming participation and may help promote physical activity amongst children in these areas, helping to reduce inequalities in child health.

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