

Do some insulin pump infusion sites have a better impact on blood glucose levels or movement and confidence levels in teenagers?

Introduction and Aims

Type 1 diabetes is a chronic autoimmune disease where the pancreas creates little or no insulin. There is no cure and no known cause. Insulin can be injected through multiple daily injections but many opt for the use of a pump. Type 1 diabetics spend a lot of time trying to predict and find patterns in their blood glucose levels, but there are a lot of things that affect blood sugars and it can be very difficult to notice/predict them all.

In this project we hope to shine a light on how putting the insulin pump infusion site in different places affects blood glucose levels, so that the type 1 diabetics using an insulin pump have one less thing to think about. In this project we also considered that some sites, while they may have better absorption of insulin, can be very obviously seen or get in the way of everyday activities such as sports or wearing certain items of clothing. Many diabetics feel self conscious when their pump can be seen or they have to do something obviously diabetes related such as blood sugar checking or injecting in public, so we wanted to consider this in which pump sites are better.



Experimental methods

Analysing the blood glucose levels

- The mean blood glucose levels from each site placement was calculated.
- We found the standard deviation.
- Results from both sites were compared using a t-test to see if they were significantly different.
- We calculated standard deviation of the blood glucose levels for values higher than the mean and values lower than the mean separately. This was done for each site in order to establish if fluctuation in glucose levels was greater in one of the sites either above or below the mean.

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{S_1^2}{N_1} + \frac{S_2^2}{N_2}}}$$

$$SD = \sqrt{\frac{\sum |x - \mu|^2}{N}}$$

Standard deviation

We performed the standard deviation six times, three times for each site, We did it once for all of the data for each site, then twice again for the higher than the mean and lower than the mean separately for both sites. We did this by writing a simple python code that took all the data and got the mean of all of it, sorted it into the blood glucose levels above the mean and below the mean and got the standard deviation of them separately. This saved time and ensured we didn't make a mistake.

Confidence and movement levels

- A questionnaire on confidence and movement levels using the Likert scale was completed by all participants.

On a scale of 1 to 5, how self conscious do you feel when the pump site/tubing can be seen? 5 being extremely self conscious and 1 being not self conscious at all.

1 2 3 4 5

Not self conscious ☐ ☐ ☐ ☐ ☐ Self conscious

Results and Statistics

Through the survey we received a total of 105 blood sugars to work with. The mean blood glucose level for the abdomen subcutaneous infusion site was 6.4 mmol/l, while the mean for the thigh infusion site was 6.7 mmol/l.

These are quite similar, so we did a t-test to determine whether the means of the data were significantly different or not. We found p to be 0.47, meaning that they are not significantly different.

This interestingly differs from the result of a similar study done in 4-6 year olds¹, however we cannot put that simply down to age as they compared abdomen to the buttocks, not the thigh.

The standard deviation for the mean and values higher than the mean for the abdomen was 2.50 mmol/L, while lower than the mean was 1.44 mmol/L. For the thigh, higher than the mean was 2.27 mmol/L and lower was 1.75 mmol/L. For both thigh and abdomen, the standard deviations for values higher than mean was greater than standard deviation for values lower than the mean by 1.06 mmol/L for abdomen and 0.52 mmol/L for thigh. This means that for the abdomen site there was more fluctuation in glucose levels above the mean value and for the thigh there was more fluctuation below the mean.

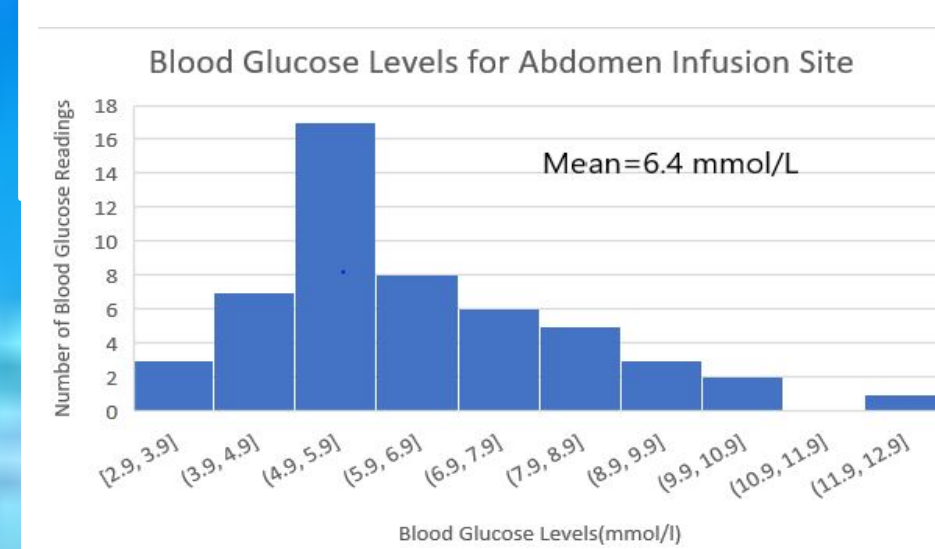


Fig. 1

Since the infusion sites in both places have similar results in mean blood glucose levels we can look at the results to the questions we asked about confidence and movement as an even more conclusive factor in deciding on which site is best to use.

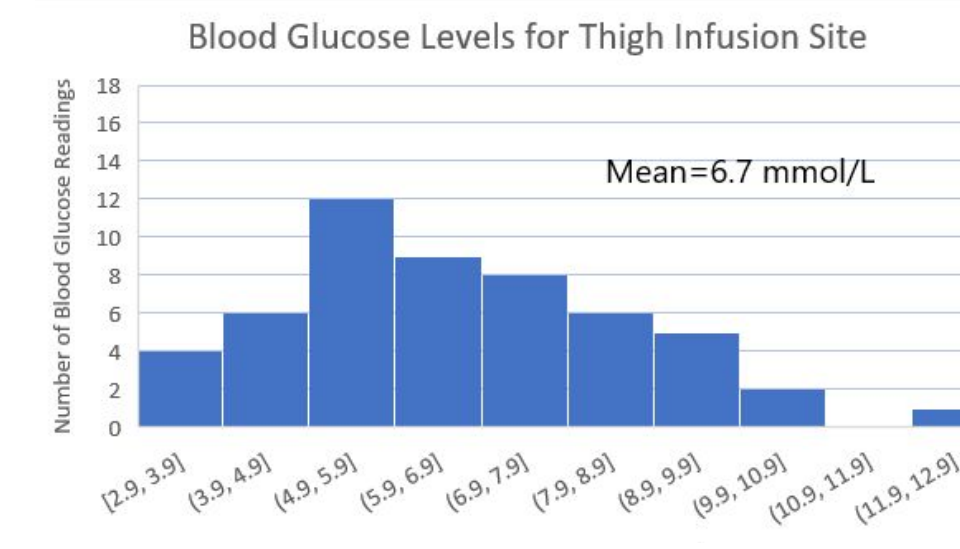


Fig. 2

Fig. 3

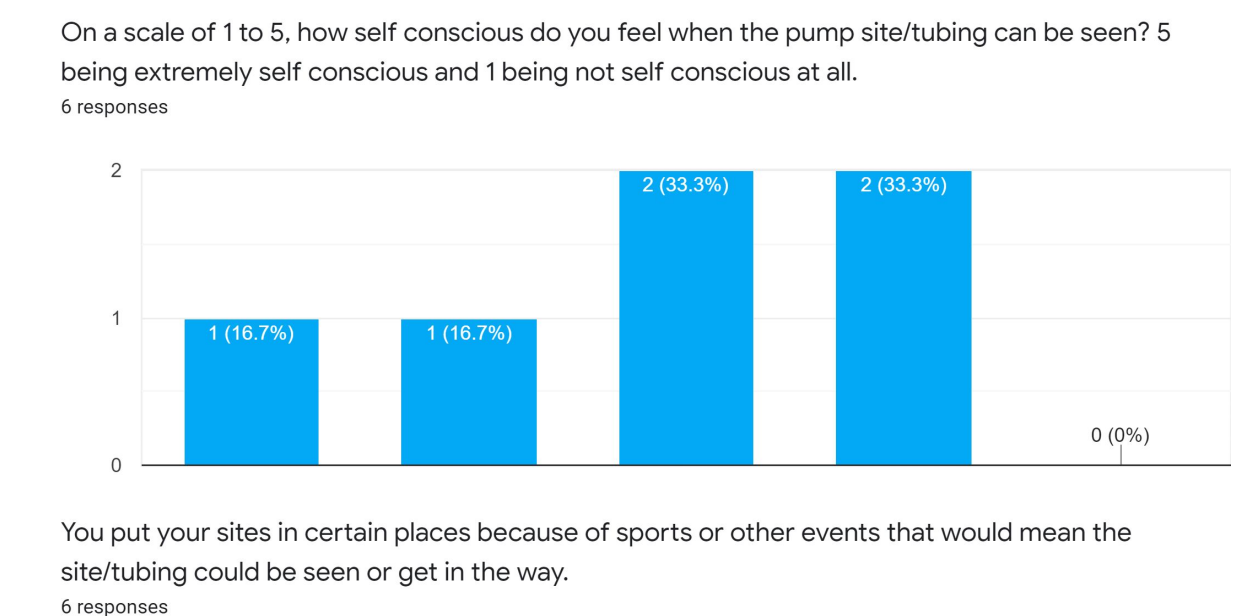


Fig. 4

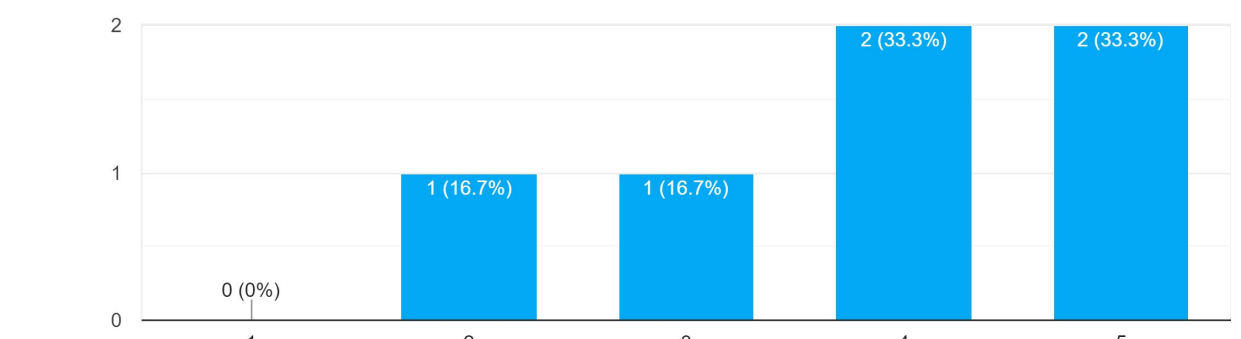


Fig. 5

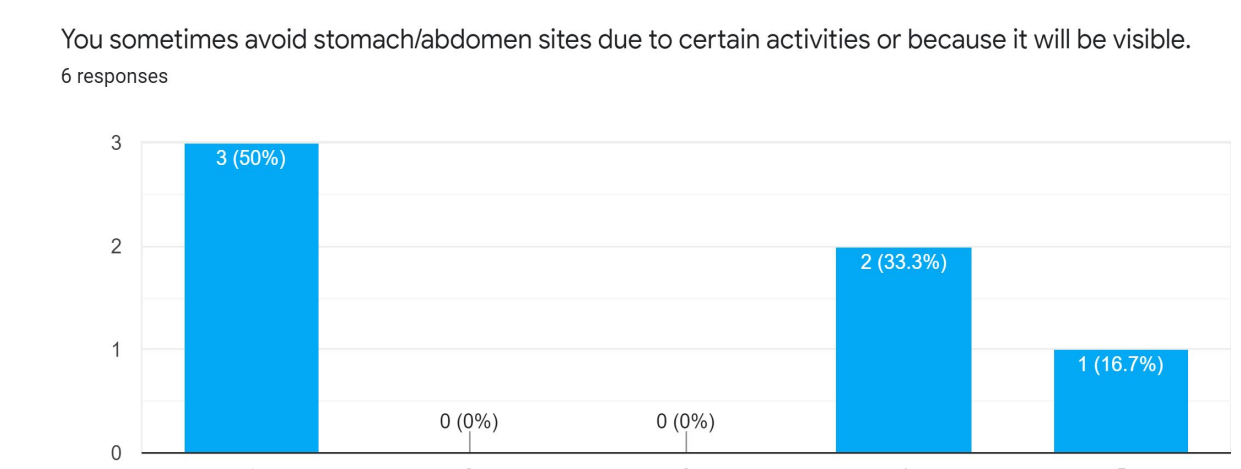
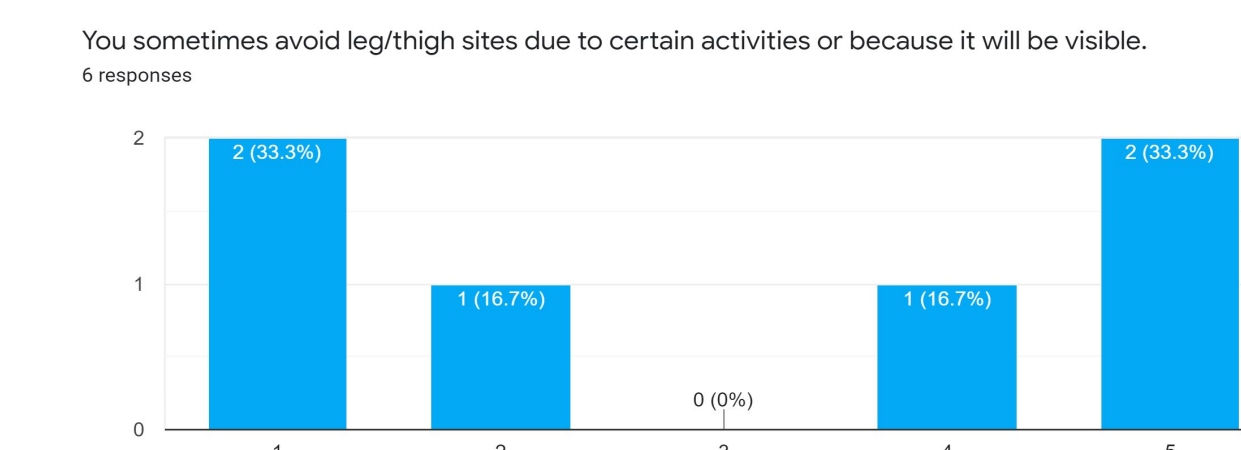


Fig. 6



Conclusion

The means, 6.4 mmol/L for abdomen and 6.7 mmol/L for thigh, were not significantly different, so abdomen and thigh subcutaneous insulin infusion sites lead to a very similar average blood glucose level. Our modified standard deviation show us that blood glucose levels while the site is in the abdomen are more likely to fluctuate higher than in the thigh, while with thigh infusion sites they are more likely to fluctuate lower than in abdomen sites.

Our data shows that 33.3% of people do feel self conscious when the pump site/tubing can be seen(see fig. 3) and it was evident that people 66.6% do put their site in a particular place for certain events or sports(see fig. 4). Since both sites are quite similar in their effect on blood glucose levels, the survey questions became a bigger factor than we had expected. In these answers, there was always a wide range of opinions, so we can see that it mainly depends on the preference of each person.

We believe these results could be useful in helping type one diabetic teenagers to choose an insulin pump infusion site. It informs them that there will be no difference in their blood glucose levels, giving them an extra bit of reassurance that nothing will go wrong and as long as they personally are comfortable with their movement levels both sites are perfectly viable options.

References: 1-Zanfardino, A., Iafusco, D., Piscopo, A., Cocca, A., Villano, P., Confetto, S., Caredda, E., Picariello, S., Russo, L., Casaburo, F. and Rollato, A.S., 2014. Continuous subcutaneous insulin infusion in preschool children: butt or tummy, which is the best infusion set site?. Diabetes technology & therapeutics, 16(9), pp.563-566.