

# The effect of weight on angle and base of gait A pilot study.

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# Background

- One of the main points highlighted by the literature review was there is very little research into how carrying weight affects the base and angle of a person's gait.
- Fischer and Wolf published some studies looking at how bodyweight unloading affected gait. They concluded that an unloading of 30% of a participants' bodyweight resulted in a significantly reduced reduction in the use of tibialis anterior, lateral gastrocnemius, vastus lateralis and rectus femoris (Fischer et al, 2015,pp.712-714).
- It would be a fair assumption therefore that an increase in bodyweight should have an increase on these muscle.

# Background

- One study that looked at the effect of carrying weight on the gait of soldiers, was carried out by Attwells *et al.* in 2006. They investigated a number of parameters and identified that weight did cause some changes such as an increased range of motion at the knee and femur and increased forward trunk lean (Attwells *et al.*, 2006, p.1200).
- This concurred with results obtained twenty years earlier by Martin & Nelson. They looked at weight and how it affected walking. They identified that an increase in load would cause an increase in stride rate and double support time, and a reduction in swing time and stride length (Martin & Nelson, 1986, p.1200). They also discovered that there are marked differences in the way that men and women walk when weight is applied (Martin & Nelson, 1986, p.1199).

# Krishan 2008

- Krishan in 2008 Used a sample of fifty Gujjar participants and investigated differences in their footprints when they were holding 5Kg weights and when they held 20Kg weights. Although Krishan didn't look at angle of gait or base of gait, the parameters he looked at didn't show any significant changes at 5Kg, but at 20Kg the results were deemed to be statistically significant.
- At 20Kg the length and breadth of a footprint was deemed to have increased, which makes it all the more feasible that the angle and base of gait could also increase. (Krishan, 2008, pp66-67).
- Krishnan's research solely used Gujjar participants.

# Gait (Forensic)

- Used to compare reference footage of a suspect with actual footage of a suspect.
- Haydn Kelly 2009.

# Research question

- Does carrying weight have an effect on a person's angle or base of gait.
- The weight would be carried to the front and to the left side of the person.

# Objectives

- 1) To determine if carrying weight to the left hand side of a person has a impact on their base of gait.
- 2) To determine if carrying weight to the left hand side of a person has a impact on their angle of gait
- 3) To determine if carrying weight to the front of someone has a impact on their base of gait.
- 4) To determine if carrying weight to the front of someone has a significant impact on their angle of gait.
- 5) At what level of weight would these significant changes occur, if any are to occur.

# Method

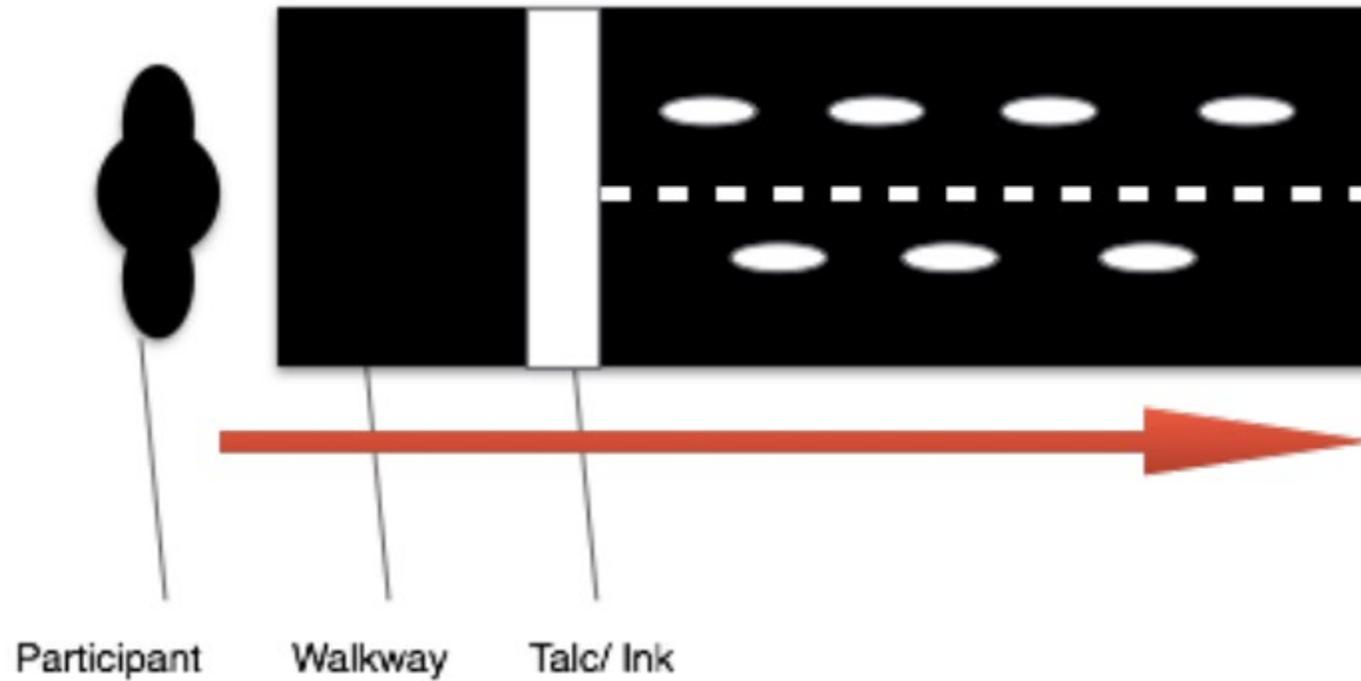
- Ethics approval from
- The University of Northampton School of Health Ethics Committee
- 15 healthy University of Northampton right handed student participants able to carry up to 15 kg of weight.(HSE guidelines maximum weight to be carried for females)

Weight 5Kg = 10 bags of sugar (UK)

Weight 15 kg ( 2 stone 5 pounds) = 30 bags of sugar.(UK)



Birds eye view of set up.



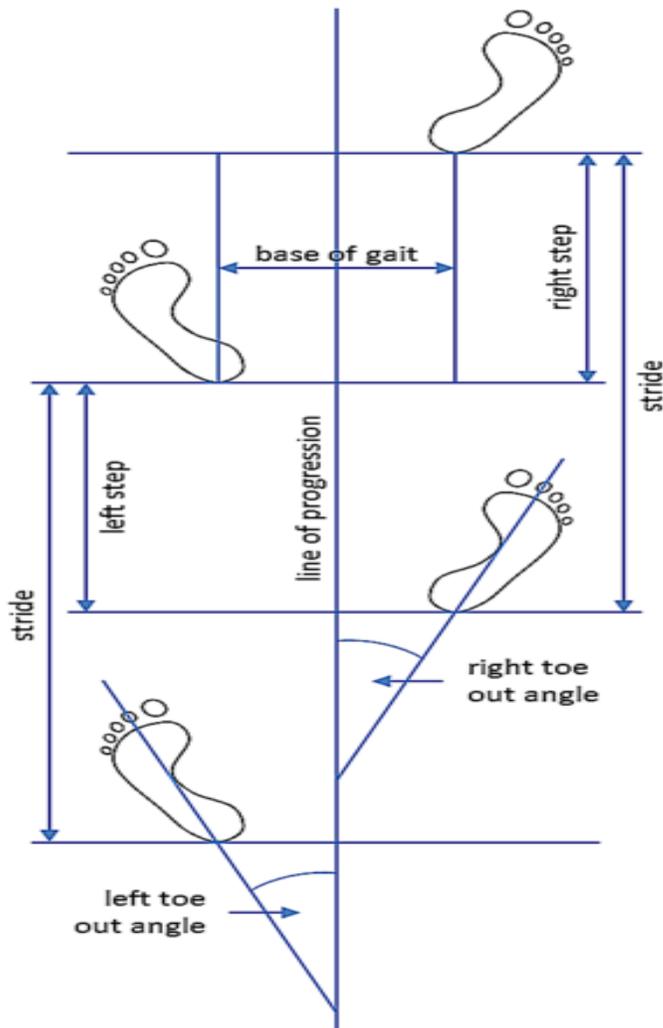
# Method

- The participant was asked to make one baseline pass, not carrying anything, followed by carrying a plastic crate, to the front of them, with increasing weights of 5kg, up to the safe maximum loads of 15Kg.
- They were then asked to carry a bag to the left hand side of their body with increasing weights of 5kg, up to the safe maximum loads identified earlier or until the participant didn't feel they could safely manage the load.
- A new walkway of plain black paper was laid down for each pass. The bag used was standard backpack with two straps for wearing over the shoulders, plus a handle on top for carrying to the side.
- The bag was capable of holding up to 20kg of weight.

# Angle and base of gait

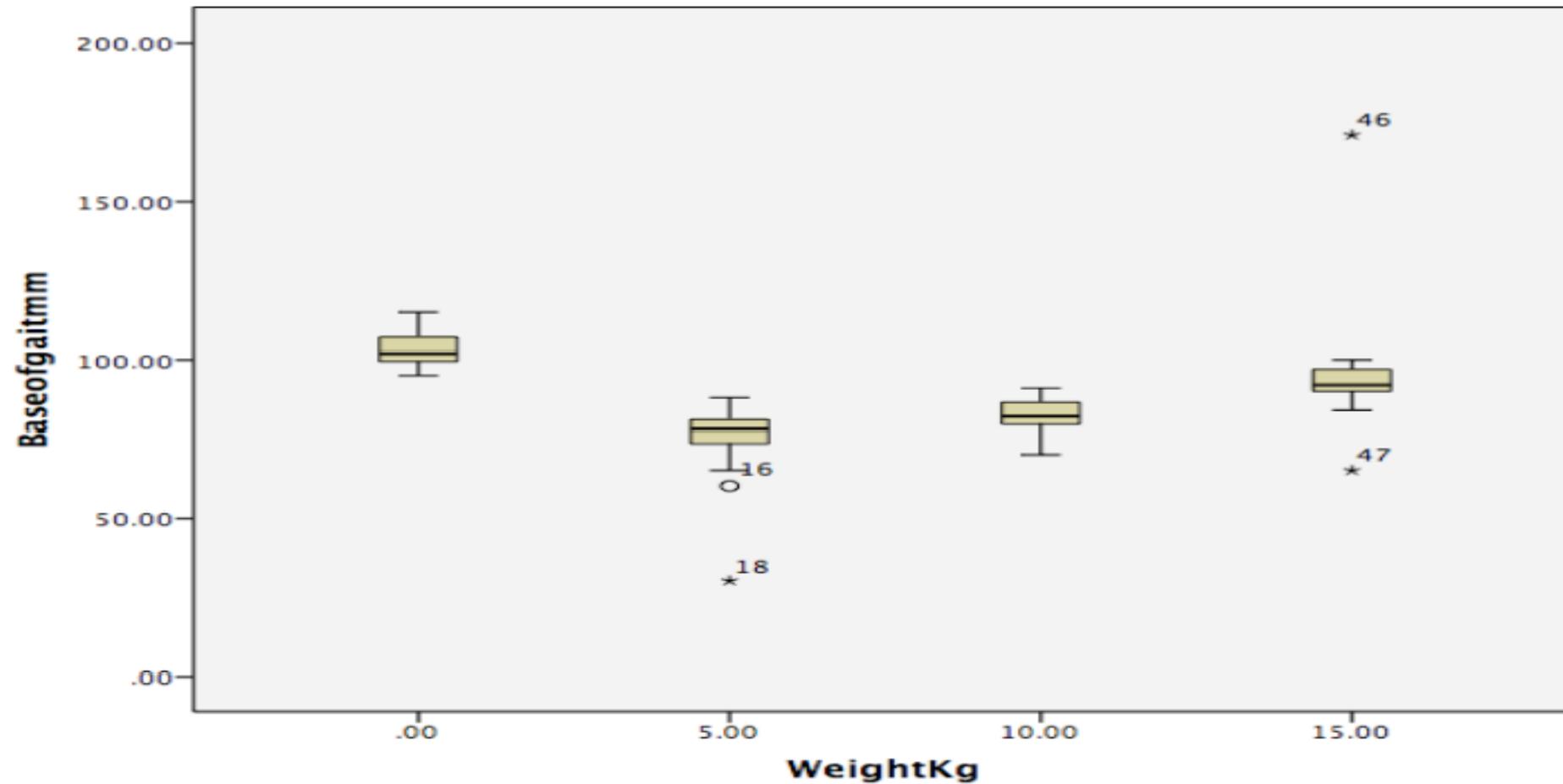
- Once all of the sheets of footprints were collected, the base and angle of gait needed to be identified for each set of footprints.
- **The base of gait** was determined by bisecting the heel area of two successive steps on an ipsilateral line of progression. The distance between the two bisections (measured with a calibrated rule) was the base of gait (Bodziak, 2000, p.6), (Wilkinson *et al*, 1995, pp88-89).
- The **angle of gait** was measured from the mid line of the foot in relation to the direction of travel (Whittle, 1996, p.62), (Dougan, 1924, p.275). This was measured using a calibrated protractor.
- The average of three pairs of footprints per pass were used, in order to reduce the chance of using an anomalous pair of foot prints.

# Angle and base of gait.



# Results

**Base of gait, carrying weight to the left hand side:**

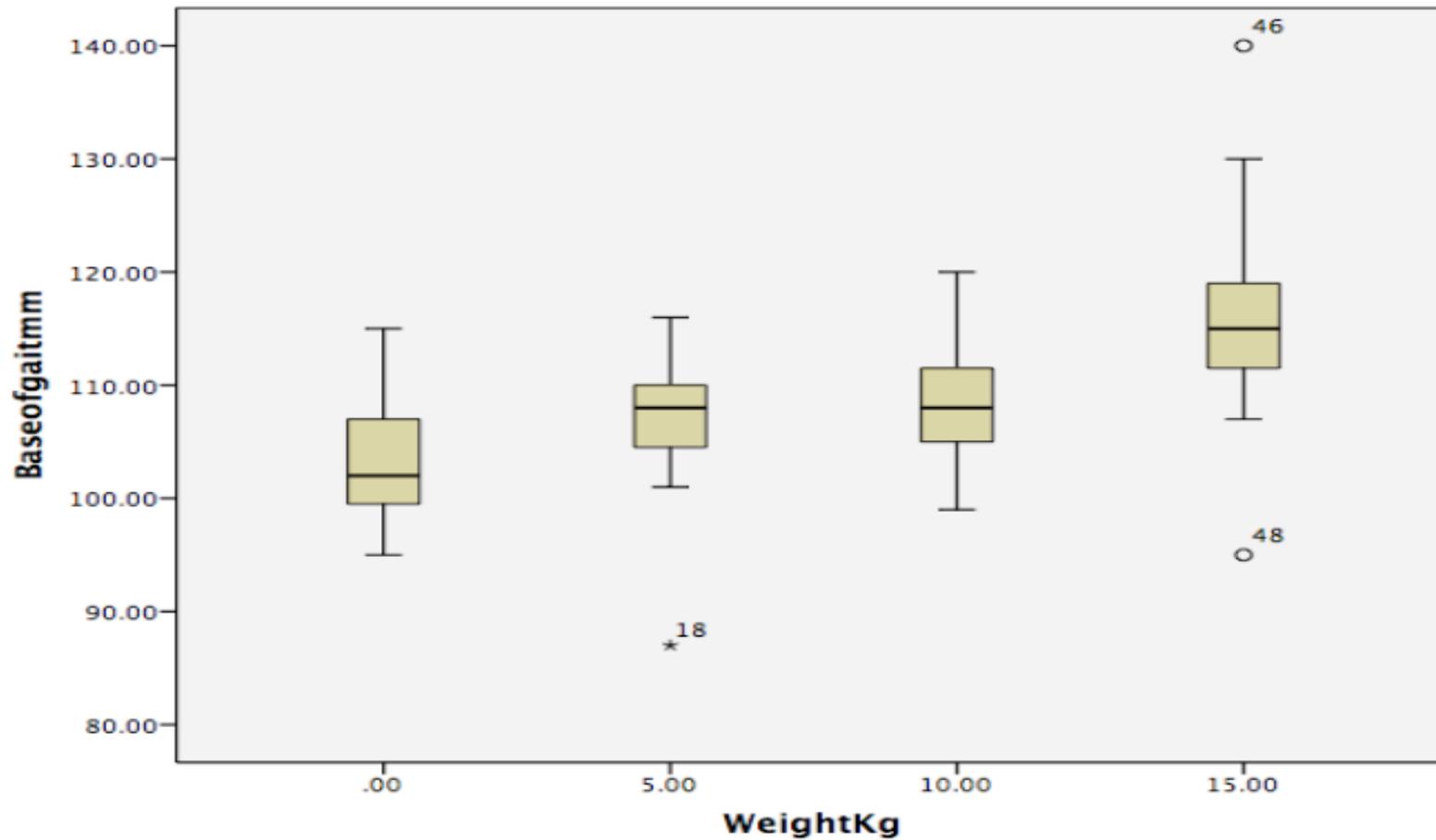


# Summary weight to LHS.

- The results show that the base of gait drastically reduces as soon as weight is applied to the individual, which then steadily increases a small amount as the weight increases.

# Results

**Base of gait, carrying weight to the front:**

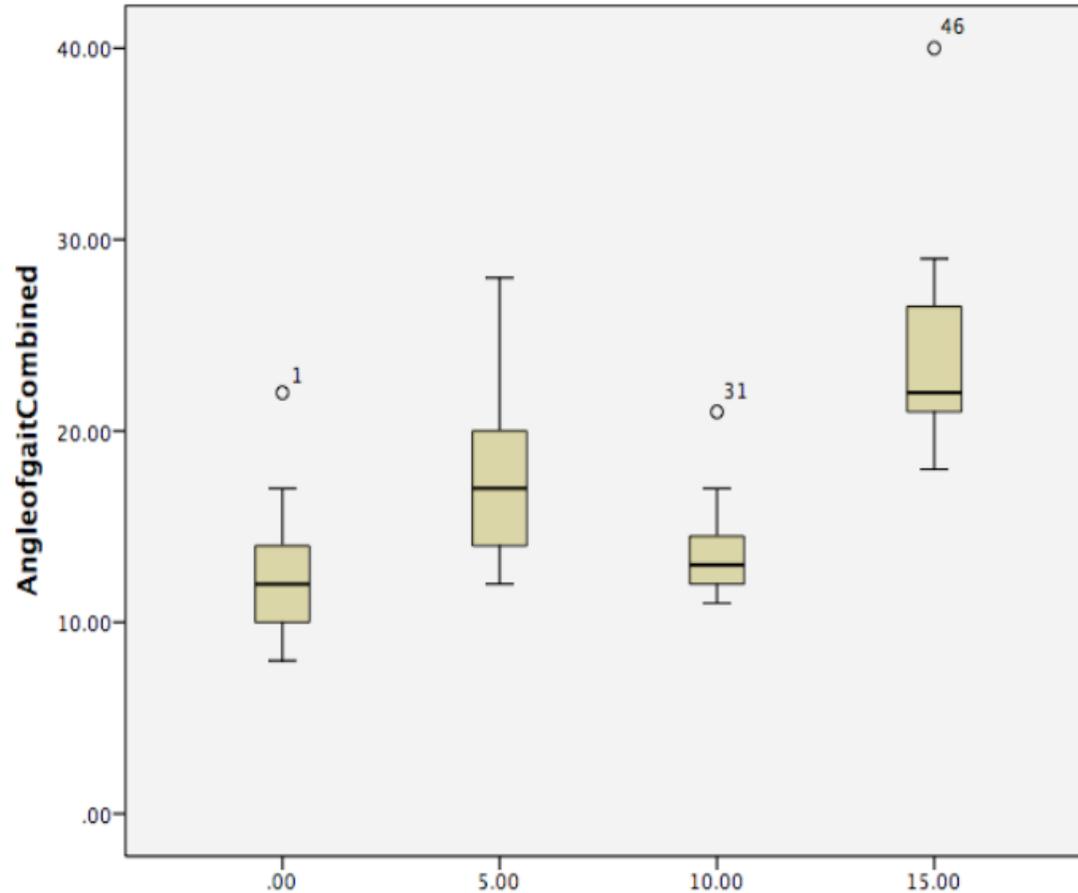


# Summary Base of gait weight to the front

- The results for carrying weight to the front show that as weight is applied the base of gait increases.
- There is very little difference in the base of gait between the 5Kg and 10Kg weight, but there is another increase at the 15Kg weight

# Angle of gait left and right foot combined

Angle of gait, carrying weight to the left hand side (Left and right foot comb

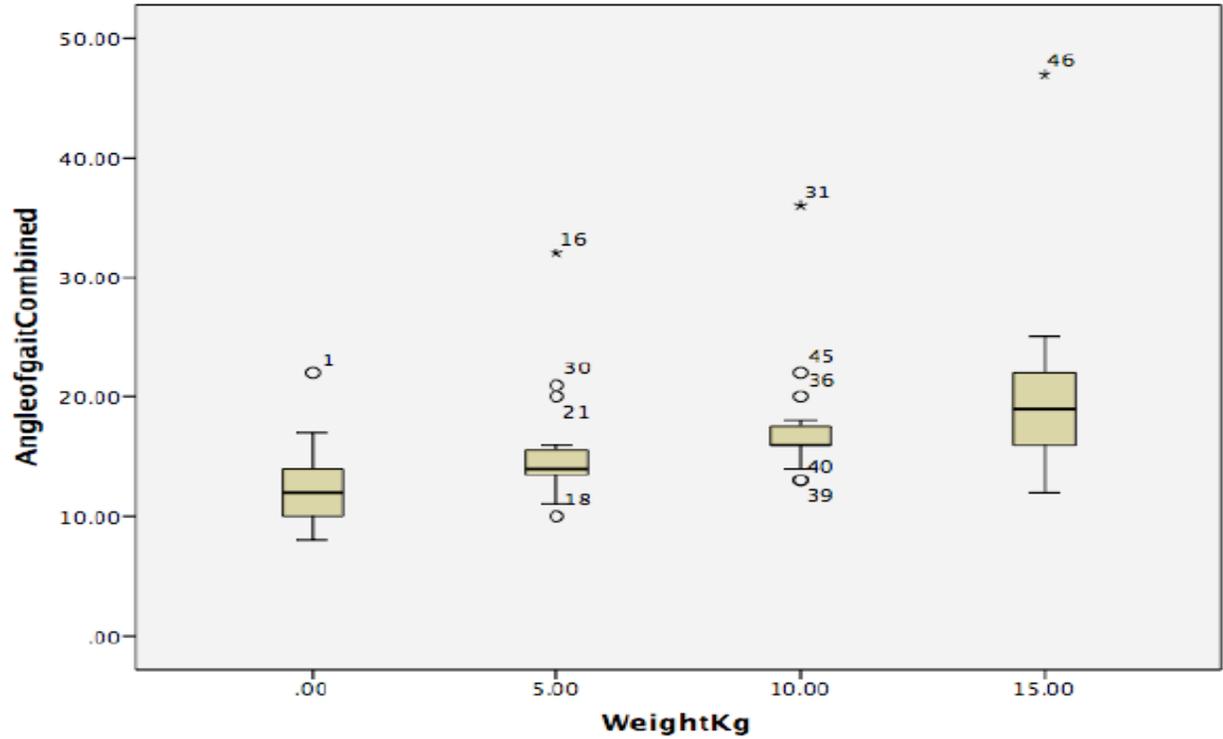


# Summary angle of gait left and right foot combined

- The data shows that overall the angle of gait shows an increase between 0Kg and 5Kg of weight, a small decrease between 5Kg and 10Kg, with another increase between 10Kg and 15Kg.

# Angle of gait weight to front (left and right feet combined)

Angle of gait, carrying weight to the front (Left and right foot combined):



# Summary weight to front left and right feet combined.

- When carrying weight to the front, an increase in the combined angle of gait as weight is increased.

# ANOVA

- 15 participants
- The results indicated that a weight of 15Kg had a significant effect ( $p < 0.05$ ) on both a person's base and angle of gait when carrying weight to the front or to the side of them.

# Observations

- Looking at the results obtained for carrying **weight to the front** it can be concluded that there is a significant effect on the base and angle of gait at 15Kg when carrying weight to the front of the body. The base of gait increases significantly and the left (non dominant) foot abducts more than the right. The body has gone from a state of propulsion to one of stabilisation.

# Observations

- From the data it can be concluded that there is a significant effect on the base and angle of gait at 15Kg when carrying weight to the **left hand side of the body**. The base of gait is decreased significantly and the left (non dominant) foot abducts an excessive amount whereas the right foot has marginally abducted.
- The body is struggling to stabilise and using the left foot as much as it possibly can to achieve this stabilisation that is needed. The base of gait has been narrowed due to the changes in the angle of gait bringing the heels closer together and the fact that the load is possibly pulling the body over to one side.
- This is supported by work by Krishan in 2008, whose results showed that changes in foot prints were only observed with loads of 20Kg (he only observed a 5Kg and 20Kg load (Krishan, 2008, pp66-67). It is conceivable he would have had similar results at 15Kg if he had used a wider range of loads.

# Further work

- Left hand dominant individuals
- Larger sample size.
- Carrying weight to the right hand side.

# Findings (forensic)

- If people are carrying weight (15kg) care with the analysis of angle and base of gait.
- Attention to small weights too.

# References

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# Questions

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