Case study

Lifting capacity at 24 weeks of pregnancy: a case contrast between a woman in a physically demanding job and one in a sedentary job

Nellie Buckley, Ev Innes, Kade Davison and Wendy Gilleard
School of Health and Human Sciences, Southern Cross University, Australia

Abstract

Background: Pregnant women are encouraged to maintain their pre-pregnancy physical activity levels, including their activities of daily living. Heavy lifting is an activity of daily living currently restricted in pregnant women; though the literature reviewing occupational activities indicates that heavy lifting during pregnancy in developed nations does not warrant mandatory restrictions, as the risks to mother and child are minimal. Lifting capacity during pregnancy has not been specifically investigated. Furthermore, it is unclear whether lifting capacity in pregnancy is more closely related to perceived capacity, as it is in injured populations or physical activity levels as it is in healthy populations. **Aims:** To (1) evaluate lifting capacity in three ranges of motion and two lifting frequencies during pregnancy; (2) evaluate perceived lifting capacity during pregnancy; (3) compare perceived and assessed lifting capacity relative to levels of physical activity (PA). **Method:** Case studies of two women at 24 weeks pregnancy with different current physical work demands. PA during the preceding three months was assessed using an adapted Kaiser Physical Activity Survey; lifting through three ranges and two frequencies was assessed by the EPICRehab© Lift Capacity test; and perceived lifting capacity was determined by self-report. **Results:** Leisure-time PA levels were similar in both participants, however occupational PA levels were different (8.17 and 8.00; 3.11 and 2.33, respectively). Lifting capacity through knuckle-to-shoulder and floor-to-knuckle ranges were similar in both participants, however their perceived lifting capacity was different. The participant with greater occupational PA consistently overestimated her lifting capacity (mean difference: +7.51 kg (occasional lifts), +3.78 kg (frequent lifts)), whilst the woman with lower occupational PA consistently underestimated her capacity (mean difference: -4.32 kg (occasional lifts), -2.27 kg (frequent lifts)). **Conclusions:** The findings of the present study need to be confirmed in a larger sample of pregnant women. Lifting capacity appears to be more closely related to leisure-time PA levels rather than perceived lifting capacity in these healthy pregnant women. Maintaining a physically demanding job during pregnancy may predispose a woman to overestimate her lifting capacity and being in sedentary employment may predispose a woman to underestimate her lifting capacity.

Background

Manual tasks and the prevention of any subsequent musculoskeletal injury remains a vital issue within Australia and other industrialised nations. The resulting costs for these injuries are very high, especially when indirect costs are considered (e.g. societal costs, changes in earning capacity, role change, etc.). In order to reduce the risk of injury in the workplace, the Australian Safety and Compensation Council generated the National Standard for Manual Tasks [1] and the National Code of Practice for the Prevention of Musculoskeletal Disorders from Performing Manual Tasks at Work [2]. While these guidelines have sufficient scope of application in industry, manual tasks including lifting are regularly performed outside the workplace. Hence, a gap is created in guidance offered to individuals regarding lifting as part of daily living. The gap may be of particular concern for pregnant women. Pregnant women lift heavy items as part of their activities of daily living (ADLs) and recreation [3]. Lifting capacity is influenced by a person's physical activity levels and perceived capacity [4, 5].

Currently, there are few guidelines regarding manual tasks and lifting during pregnancy. Common perception is that pregnant women should limit their physical activity [6] and particularly the amount they lift. Furthermore, a majority of antenatal care providers recommend lifting restrictions with the occurrences of restrictions increasing as pregnancy progresses [7]. Common perception and restrictions exist, despite the Royal Australian and New Zealand College of Obstetricians and Gynaecologists' recommendation that pregnant women maintain their typical physical activity levels [8]. Equally, a systematic review of occupational physical activities and pregnancy did not support mandatory lifting restrictions [9]. Additionally, a previous study reported that lifting capacity is not reduced during pregnancy [10]. However, as an incremental capacity assessment protocol was not utilised [10], further investigation is required for confirmation.

People who have sustained a musculoskeletal injury, often as a result of lifting, perceive their functional capacity as lower than it actually is [5]. This underestimation, however,

Corresponding author: Nellie Buckley. Email – nellie.buckley@scu.edu.au

is not unique to an injured population. Healthy, uninjured people also have an inaccurate perception regarding their actual capacity, although without the same consistent bias toward underestimation [11]. Currently, research has not investigated the impact pregnancy may have on perceived and actual lifting capacity. Therefore, this study investigates perceived and actual lifting capacity during pregnancy. The two case studies presented here aim to, firstly, evaluate perceived lifting capacity at 24 weeks of pregnancy; secondly, evaluate lifting capacity with an incremental functional capacity evaluation at 24 weeks of pregnancy; and finally, compare perceived and actual lifting capacity relative to levels of physical activity.

Method

Two women at 24 weeks gestation with different current physical work demands participated in this study. Ethical approval was granted by the Southern Cross University and North Coast Area Health Service Human Research Ethics Committees (Approval no. ECN-10-182 and 495N, respectively). Both participants provided written informed consent prior to inclusion and had singleton gestations, uncomplicated pregnancies and no history of musculoskeletal injury. Each participant's typical physical activity levels were surveyed and their perceived and actual lifting capacities were assessed.

Physical activity levels during the preceding three months were assessed using an adapted Kaiser Physical Activity Survey (KPAS) [12, 13]. The KPAS includes a physical activity index score for household and care-giving, occupational, active living and sport and exercise physical activities. The physical activity indices range from zero to five. The active living and sport and exercise indices represent leisure-time physical activity. An average leisure-time physical activity index score of 3.75 or more is equivalent to 150 minutes or more of moderate to vigorous physical activity per week complying with the national guidelines for health and fitness [8] and thus, representing a highly active individual. Perceived lifting capacity was determined by self-report in accordance with previous research [5, 11]. Participants were asked 'How much do you expect to lift, in kilograms?'[5] for each component of the EPIC Lift Capacity test.

After the perceived capacity was recorded, each participant's maximum acceptable weight of lift was assessed using the EPIC Lift Capacity test [14]. The six EPIC Lift Capacity sub-tests are lifts through three ranges (knuckle-to-shoulder, floor-to-knuckle and floor-to-shoulder) at two frequencies (occasional – 1 lift/30 sec, frequent – 4 lifts/30 sec). For safety and validity, the shelf heights were adjusted according to each participant's height to ensure correct range of motion. Actual lifting capacity was deemed to have been reached when one of the following occurred: participant's heart rate exceed 85% of age predicted maximum rate during a lifting cycle; participant was unable to correct her stance or the horizontal distance to load required for safe lifting; participant rated the load as 'very heavy' or higher; participant felt she could not perform the task safely and dependably 8 - 12 times a day; or participant felt she could not handle more weight.

Results

The participant characteristics and physical activity indices are presented in Table 1. The participants varied in age, the number of children under five years at home, and their occupations. Both participants engaged in high levels of leisure-time physical activity and achieved the recommended levels for health and fitness [8], though differences were observed in ADL. Participant 1 had higher levels of household and care-giving and occupational physical activity than Participant 2.

The participants' actual and perceived lifting capacities are presented in Table 2 for the three ranges of motion and two frequencies. In Figure 1, each participant's perceived lifting capacity is expressed as a percentage of her actual lifting capacity for each of the EPIC Lift Capacity sub-tests. Overall, Participant 1's total physical activity level (Table 1) and actual lifting capacity (Table 2) were higher than Participant 2, although Participant 1 consistently overestimated her capacity (Figure 1). Participant 2, while still highly active, had more sedentary occupational and household and care-giving roles (Table 1). She had consistently lower actual lifting capacity (Table 2) and she underestimated her capacity to lift (Figure 1).

Table 1. *Participant characteristics and physical activity indices (range = 5) for each participant in the household and care-giving, occupational, active living and sport and exercise physical activity*

	Participant 1	Participant 2
Weeks gestation	24	24
Age (years)	28	39
Education	Tertiary	Tertiary
Household Income	$70,000+	$70,000+
Children under 5	1	0
Mass (kg)	77.6	75
Height (m)	1.67	1.71
Occupation	Exercise Health Professional	Travel Sales Manager
	Physical Activity Index (0-5)	
Household a Care giving	3.78	1.78
Occupational	3.11	2.33
Active Living	3.50	4.00
Sport & Exercise	4.67	4.00

Table 2. *Participants' Actual Lifting Capacity (ALC) and Perceived Lifting Capacity (PLC) for three ranges of motion and two frequencies (occasional lifts – 1 lift lower cycle per 30 seconds; frequent lifts – 4 lift lower cycles per 30 seconds)*

	Participant 1	Participant 2
Occasional Lifts	***ALC (PLC) kg***	
Knuckle-Shoulder	27.3 (40)	22.7 (10)
Floor- Knuckle	27.3 (45)	22.7 (15)
Floor- Shoulder	27.3 (30)	18.2 (10)
Frequent Lifts	***ALC (PLC) kg***	
Knuckle-Shoulder	25 (35)	18.2 (10)
Floor- Knuckle	25 (35)	18.2 (15)
Floor- Shoulder	25 (30)	13.6 (10)

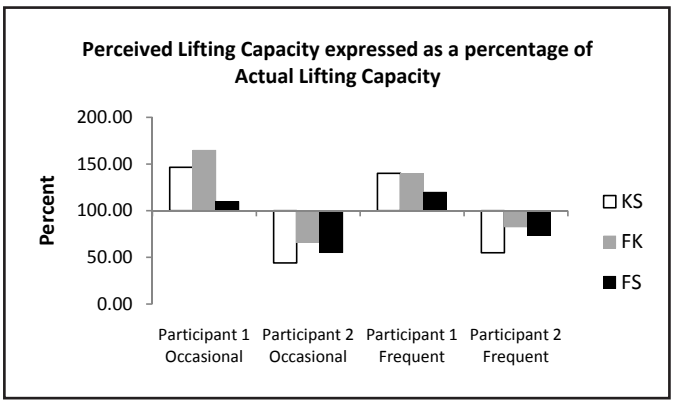

Figure 1. *The Perceived Lifting Capacity (PLC) of Participants 1 and 2 expressed as a percentage of Actual Lifting Capacity (ALC) for three ranges of motion and two lifting frequencies. Numbers below 100% represent that PLC was an underestimation of ALC (PLC<ALC). Numbers above 100% represents that PLC was an overestimation of ALC (PLC>ALC). KS – Knuckle-to-shoulder lift; FK – Floor-to-knuckle lift; FS – Floor-to-shoulder lift; Occasional – 1 lift and lower per 30 seconds; Frequent – 4 lifts and lowers per 30 seconds*

Discussion

The present study compared the perceived and actual lifting capacities and physical activity levels of two pregnant participants. Both participants successfully completed the EPIC Lift Capacity test and reported no musculoskeletal complications 48 hours post-testing. In essence, this demonstrated the safety of the EPIC Lift Capacity Test for assessing functional lifting capacity in these pregnant women. To rank participants' actual lifting capacity, normative data for each of the six EPIC Lift Capacity subtests have been established for healthy individuals grouped on gender and age. The actual lifting capacity of Participant 1 averaged in the 45th percentile when normalised by body weight, while Participant 2 averaged in the 25th percentile [14]. Matheson [15] found that body weight was the most influential predicting factor for lifting capacity in healthy individuals. However, Sinnerton and colleagues [16] suggest that this relationship may not be present during pregnancy. Actual lifting capacity was reported in kilograms for the present study. Interestingly, the participants' body weights were within three kilograms of each other, but their actual lifting capacity had wider variation. Hence, the present study supports the results of previous research [16], suggesting that classifying lifting capacity as a proportion of body weight during pregnancy may not be appropriate. Further research is required comparing pregnant women's lifting capacity to that of non-pregnant women with similar influential characteristics, such as physical activity levels.

Both participants had high leisure-time physical activity levels, consistent with high household income and tertiary education [17], achieving the recommended amount of physical activity [18]. The participants' physical activity is in contrast to that of the typical pregnant woman, whose physical activity levels decline [17], even in previously active women [19]. Within the sport and exercise physical activity index, both participants reported engaging in aerobic fitness and strength training, including weight lifting. Therefore, these factors are unlikely to account for the discrepancy in actual lifting capacity between these participants.

Participant 1 had a higher level of household and care-giving physical activity as she cares for a child under five years old for more than 20 hours a week, while Participant 2 does not. Participant 1 also had a more active occupation, reporting 'heavy lifting' being performed 'often'. In contrast, Participant 2 reported 'never' performing 'heavy lifting'. Participant 1, with higher 'required' physical activity levels (occupational and household and care giving) and therefore higher total physical activity levels, had the higher actual lifting capacity. Participant 2, who achieved a similar level of leisure-time physical activity, but a lower level of 'required' physical activity, and, therefore, lower total physical activity, had the lower actual lifting capacity. Given these points, it would seem that lifting capacity has a positive relationship with total and 'required' physical activity levels in these healthy pregnant women. These 'required' physical activities, such as caring for a toddler and performing manual tasks at work, are generally considered ADLs. Therefore, all forms of physical activity, including ADLs, should be investigated when functional capacity is considered.

When completing lifting as part of leisure-time physical activities, the participant can choose the objects and subsequently the weight she lifts. Whereas in the household and occupational settings, the weights are often unknown and the choice to lift or not is absent, as objects must be lifted in order to complete the task. A person that completes lifting in the household and occupational settings may become more capable due to the necessity of lifting. As a result, lifting within the household and occupational settings has the ability to influence lifting capacity. Previous research has not found a correlation between physical activity and lifting capacity in pregnant women past 14 weeks gestation [4]. The observation that lifting capacity may be related to ADLs at 24 weeks gestation may explain the lack of correlation, as the previous research only investigated leisure-time physical activity [4]. Hence, the lack of correlation between physical activity and lifting capacity at 24 weeks gestation and the later stages of pregnancy [4] may result from lifting capacity remaining unchanged [10], while leisure-time physical activities declined. The observation that actual lifting capacity may be more closely linked to ADLs during pregnancy, rather than leisure-time physical activities, warrants further investigation.

Perceived lifting capacity patterns were consistent with functional lifting capacity expectations, being highest in the lifts with a small range of motion and lowest in the floor-to-shoulder lift [14]. Also consistent with literature, perceived lifting capacity of frequent lifts was more accurate than of occasional lifts [11]. The lifting range in which each participant was most accurate varied (i.e. Participant 1 – FS occasional; Participant 2 – FK frequent) and may reflect varying levels of experience with each range and/or frequency.

The percentage difference in perceived and actual lifting capacities was a distinction between the participants. Despite participants achieving similar levels of leisure-time physical activity, including lifting weights at a gym, Participant

2, with a sedentary job and no young children at home underestimated her lifting capacity. This underestimation is consistent with a large portion of healthy females in sedentary occupations [11] and an injured population [5]. In healthy women, perceived lifting capacity is not correlated with actual lifting capacity: 37% accurately perceived their actual lifting capacity (within 5 kg); 16% overestimated their lifting capacity; and 47% underestimated their capacity [11]. For persons with a limited functional capacity (i.e. those with a history of injury, pain or a disability), perceived lifting capacity has been found to be a predicting factor in functional capacity evaluations [5]. Hence, it may be that Participant 2 resembles the proportion of healthy women that tend to underestimate their capacity. On the other hand, the underestimation may represent a similarity to an injured person who consistently underestimates his/her capacity. To clarify this issue, further investigation is needed.

An alternative explanation for the underestimation by Participant 2 may be the potential for pregnant women to receive conflicting or erroneous advice regarding lifting during pregnancy. Almost a third (32.7%) of pregnant Australian women reported performing 'heavy lifting' (i.e., lifting an object of more than 12kg) as part of their ADL [3]. The literature, including a meta-analysis of lifting at work and negative birth outcomes that has been applied as the national guideline in the UK [20], does not support mandatory lifting restrictions during pregnancy [9]. Despite this, women are often advised to restrict their lifting during pregnancy, particularly in occupational settings [7]. Furthermore, while being advised to restrict lifting, women are also encouraged to continue their pre-pregnancy physical activities throughout pregnancy. This conflicting information may negatively impact a pregnant woman's perceived and actual lifting capacity. Further research is required to inform guidelines for pregnant women's lifting in order to overcome this disparity in advice given to pregnant women.

Unlike Participant 2, Participant 1 overestimated her lifting capacity. It was expected that someone who lifts known weights as part of her daily physical activities would have an accurate perception of her lifting capacity. Lifting known weight may come in the form of lifting labelled and considered weights as part of one's occupation or lifting a toddler whose body weight a parent knows. However, contrary to expectations, Participant 1 was not more accurate in her perception of her lifting capacity. Participant 1 overestimated her capacity by up to 60%; therefore it would seem that experience with lifting known quantities does not ensure an accurate perceived lifting capacity. It may be that Participant 1's actual lifting capacity decreased as a result of pregnancy, while her ability to do her job and therefore her perceived lifting capacity did not. On the other hand, she may represent the 17% of healthy women that overestimate their lifting capacity [11]. It is suggested that lifting as part of one's 'required' daily activities increases perceived capacity more so than lifting as part of leisure-time physical activity. The inaccuracy in perceived lifting capacity has the potential to limit safe and healthy physical activity [20], or increase the risk of musculoskeletal injuries [11], hence further investigation is required.

The present study was the first step in building on the work of Reilly and Cartwright [10], who demonstrated that lifting capacity did not change from 26 weeks of pregnancy through to 12 weeks postpartum. However, compared to an age-matched control group, pregnant participants lifted significantly less [10]. It is unclear if this difference in lifting capacity was seen as a result of pregnancy or differences between the groups' other influential factors, such as total physical activity levels. As total physical activity typically declines during pregnancy [17], it is plausible a parallel reduction in lifting capacity was observed in the pregnant group; whereas the age-matched control group may not have had a decline in physical activity. Further research is required comparing pregnant women's lifting capacity to that of non-pregnant women, not only matched for age, but also physical activity and ADL lifting levels. A limitation of the present study is that no psychosocial factors apart from perceived lifting capacity were investigated. Other psychosocial factors may influence actual and perceived lifting capacity [5]. While beyond the scope of the present study, investigation of the psychosocial factors that may influence a pregnant woman's functional lifting capacity is warranted.

Reilly and Cartwright [10] used an adaptation of Snook's psychophysical methodology, rather than incremental methodology. Their methodology required the person to select a maximal acceptable load based on their perception of the load instead of an incremental test. Those authors employed this method intentionally to ensure that each participant could apply her subjective judgement, thought to be critical for pregnant women [10]. In the present study, perception and lifting capacity were investigated separately, though perceived exertion was a factor in determining the actual lifting capacity. This is what distinguishes between a 1-repetition maximum measure of lifting and a functional capacity evaluation that results in a measure of the maximal acceptable weight of lift. The average actual lifting capacity for both participants (22.54 kg) was higher than the maximal acceptable load for lifting reported for the pregnant group (5.65 kg) at the same stage of pregnancy [10]. Further research is required to investigate actual lifting capacity in all stages of pregnancy, to see if it will remain higher than that found by Reilly and Cartwright [10].

The average actual lifting capacity of 22.54 kg in the present study corresponded to a load that was perceived as 'heavy' or 'very heavy'. The pregnant participants, in the present study, felt they could safely and dependably lift 'heavy' loads. Therefore an incremental assessment of functional lifting capacity seems to be achievable in pregnant women, as does assessing a range of lifts and frequencies. Further research incrementally assessing the lifting capacity of pregnant women is required to contribute to the evidence-base for lifting guidelines during pregnancy. Research contributing to the evidence-base for lifting guidelines needs to investigate all stages of pregnancy including the postpartum.

Conclusion

In conclusion, actual lifting capacity was higher in these pregnant women than reported previously [10]. This may be attributed to participants' high levels of leisure-time physical activity, a factor not previously reported. Actual lifting capacity is differentiated by occupational and household and care-giving ADLs, including lifting, more so than leisure-time physical activity levels between these pregnant women. Further research is required to investigate this relationship at all stages of pregnancy where all forms of physical activity are assessed. Lifting capacity appears to be more closely related to physical activity levels rather than perceived lifting capacity in these healthy pregnant women. Perceived lifting capacity was not accurate in either participant. Sources of this inaccuracy may be pregnant women feel less capable of lifting, similar to a reduced function population; conflicting information given to pregnant women including the recommendation to restrict lifting given by antenatal care providers; or continued employment in an occupation where lifting is required. An inaccuracy in perceived capacity has implications in musculoskeletal injuries and maintaining a healthy level of physical activity during pregnancy that warrant further investigation. The findings of the present study need to be confirmed in a larger sample of pregnant women. Future comparisons between pregnant and non-pregnant women's lifting capacity, when matched for age, physical activity and ADL lifting levels will inform guidelines for lifting during pregnancy. An incremental assessment of functional lifting capacity is achievable in pregnant women, as is assessing a range of lifts and frequencies. Further research incrementally assessing the lifting capacity of pregnant women across all stages of pregnancy and postpartum is required to contribute to the evidence-base for guidelines regarding lifting during pregnancy.

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