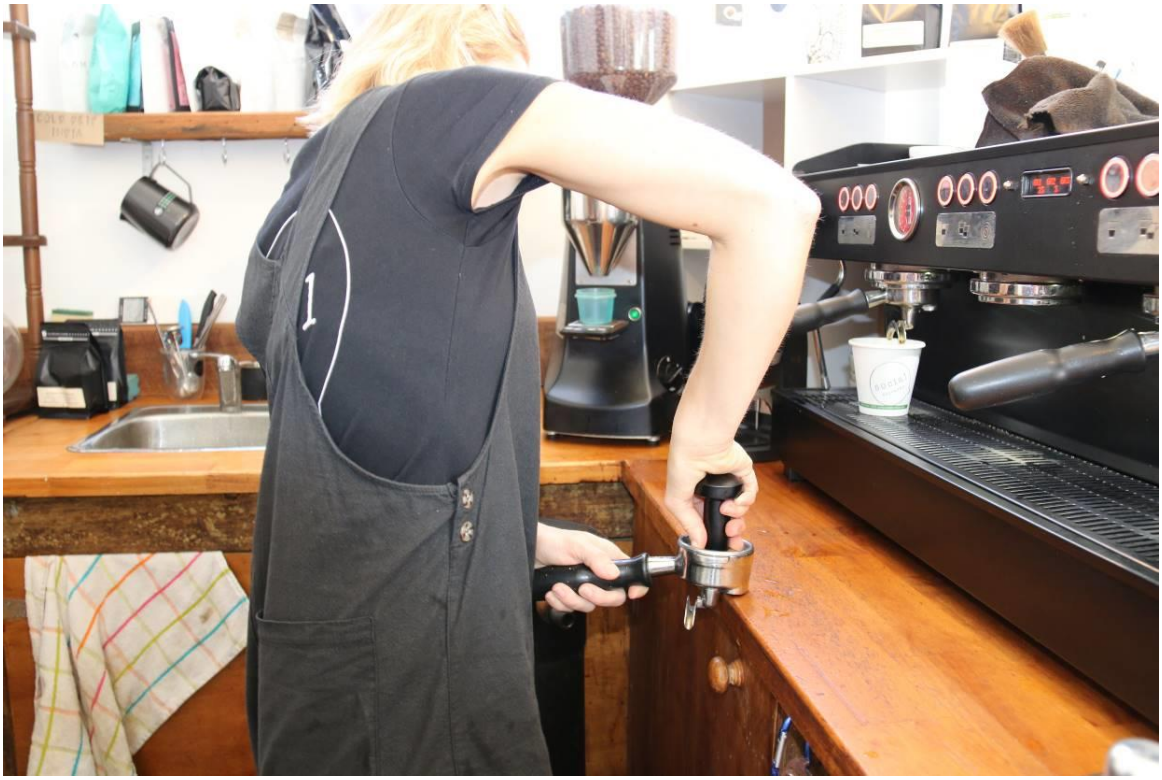
Ergonomic Study

Musculoskeletal Injury Risks for baristas –
A Comparison between Manual Tamping and the Puqpress



For BARISTA TECHNOLOGY AUSTRALIA

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Musculoskeletal Injury Risks for baristas - *A Comparison of Manual Tamping and the Puqpress*

1.0 Introduction

An ergonomics survey was conducted at Barista Technology Australia, Gold Coast on the 20th December 2018 at the request of Joanne Simonelli, on behalf of Barista Technology Australia.

Barista Technology Australia website suggests that the Puqpress is one of the fastest growing barista tools in the world and has already taken the Australian Specialty Coffee Industry by storm! It is said that the original founder of the Puqpress noticed espresso bars were facing problems while tamping their coffee. The biggest issues were level tamping, wrist fatigue and especially inconsistency between alternating baristas.

Benefits of buying a Puqpress ("Why Buy a Puqpress") are advertised to include: more precise shots with reduced channelling and improved flavour; no RSI issues; constancy between every Barista, speeds up the workflow – calm baristas and happy customers and industry proven technology.

A recent risk assessment report 'Upper Limb Injuries in Baristas' [1] explains that Puqpress is a product designed specifically for this risk. It automates the process of tamping and takes all manual tasks out of the process (i.e. eliminates the risk), this solving the problem for baristas and their employers.

The application of this to the coffee making process would eliminate the risk from tamping and therefore reduce the overall risk for baristas significantly. The Puqpress provides a simple option to completely eliminate this risk and therefore reduce the injuries to baristas [1].

1.1 Aims of Assessment Program

The aim of this study was to further identify and assess the factors that may increase the likelihood of developing musculoskeletal injury during manual tamping by baristas during the coffee making process.

The assessment involved the comparison between traditional manual tamping and use of the Puqpress machine by baristas. The objective was to assess the comparative musculoskeletal hazards and associated risk factors, and potential injury impact when using this machine during the same Barista tasks of tamping coffee.

1.2 Outcomes of Assessment Program

The primary outcome of this assessment was to identify and reinforce the benefits of using the Puqpress in Barista tasks for reducing injury risks, worker fatigue and even potential for improved productivity and quality of the resultant final coffee.

1.3 Background Information

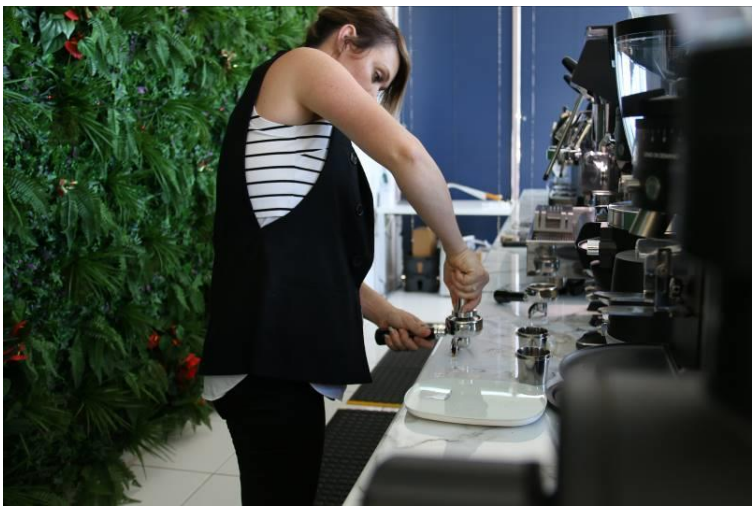
The coffee industry is a rapidly growing industry with studies showing that in 50% of the population, equivalent to 150 million Americans, drink espresso, cappuccino, latte, or iced/cold coffees [2]. There is

a substantial number of individuals now employed in this industry who are potentially at risk of developing lower back and upper extremity pain. A number of studies suggest that baristas are at a significant risk of injury [3].

Baristas who work preparing espresso-based coffees can make up to and in excess of 400 coffees per day, and although we may not think about the forces and stresses involved in these activities, many baristas complain of low back, shoulder and wrist pain as a result of the work they perform daily.

The particular step in the process that involves compressing the ground coffee into a porta filter (inserted into a group handle) prior to extracting the espresso shot of coffee is called tamping. This is one of the most crucial parts of the process that effects the end quality of the coffee. It is also reported by many baristas to be one of the most strenuous tasks in making an espresso-based coffee

Photo 1: Tamping coffee



1.4 Injury frequency and risks

A recent recent risk assessment report 'Upper Limb Injuries in Baristas' [1] states that a number of papers over the last 5 years show some alarming statistics including:

- 73% of baristas experience low back pain
- 68% of baristas experience shoulder pain

Although specific workers compensation injury data is not available for baristas, the Queensland Workers Compensation Statistics report 2017-2018 [4] reveals the following statistics relevant to the food and beverage industry:

- The average finalised time lost claim cost was $12,926 and average 44.3 days
- Total statutory claim payments in 2017-2018 for Accommodation and Food Services was $39.1M
- Average cost by injury type:
    - Strain/sprain Shoulder = $27,677

- Strain/sprain back = $13,110
- Strain/sprain other = $13,681
- Diseases of the Musculoskeletal system = $21,316

It is clear that the tasks involved within the food and beverage industry are contributing to injuries that are costing all parties, and with the average cost of a back or shoulder workers compensation claim between $13,000 and $27,000 there is very good reasons for employers to be seeking risk control solutions to reduce the associated risks.

A recent study into the '*Prevalence of occupation-related pain among baristas and an examination of low back and shoulder demand during the preparation of espresso-based beverages'* [5] is referred to in this report. This study documented the prevalence of LBP and shoulder pain among a population of baristas to determine whether cumulative low back loads and shoulder moments are associated with pain reporting. A number were also video-recorded for biomechanical analysis while making espresso beverages and cumulative and peak low back loads and shoulder moments were calculated. [5]

This same study found that, of those surveyed, at least half of baristas who suffer from low back or shoulder pain attributed this pain to their job. During manual tamping, it was observed that baristas put their body into awkward positions in which they then apply considerable force vertically down into the filter to make the desired puck of coffee.

In addition to the LBP findings, baristas who experienced shoulder pain related to their work also displayed greater peak and cumulative shoulder adductor, internal rotation and extensor moments while making espresso-based drinks. During the more in-depth biomechanical examination, low back and shoulder postures and joint loading were determined while making espresso-based drinks. [5]

Research into previous documented risk assessments and studies into shoulder and back pain for baristas have provided a range of prevention strategies and risk control solutions which ultimately fall into the lower levels of risk control such as:

- Storage of milk jugs at appropriate heights
- Considering movements, postures and techniques when tamping
- Design of workplaces, benches and equipment layout
- Installing thick rubber/ anti-fatigue mats on the floor
- Wear appropriate shoes
- Job and task rotation

These risk control strategies, although providing minimal reduction in injury risks and fatigue for operators in this industry, have had limited effectiveness in controlling the inherent risks that exist within this occupation.

2.0 Executive Summary

This ergonomics survey indicated:

1. There is a substantial number of individuals now employed in this industry who are potentially at risk of developing lower back and upper extremity pain
2. Previous risk control strategies have had limited effectiveness in controlling the inherent risks within this occupation
3. The tamping process may significantly, over time, gradually contribute to pain of the low back and/or shoulder arm and wrist regions in baristas.
4. Tamping has been found to contribute to musculoskeletal injuries, due to the risks including sustained and awkward postures in combination with repetitive and sustained force involved during manual tamping
5. The most effective control measure involves eliminating the hazardous manual task and its associated risk.
6. Puqpress automates the tamping process, replacing manual tamping. This has achieves the most effective control measure by eliminating the hazardous manual handling task involved in manual tamping, and the associated risks.

The study referred to in section 1.4 [5] stated that the implementation of an automatic tamping system rather than the use of a manual tamper will reduce the forces acting on the shoulder and low back as well as the time spent in non-neutral postures which will help to reduce the risk of pain development.

Puqpress has achieved this goal of automating the tamping process therefore eliminating the risks associated with manual tamping. The results of this assessment conducted at Barista Technology Australia support the claims that potential benefits of the Puqpress will be 'calm baristas and industry proven technology'.

3.0 Methodology

The ergonomics survey was carried out at the premises of Barista Technology Australia, utilising the training/show room and all associated equipment required for typical Barista tasks and the process of making coffee (full simulation of a typical café). The equipment utilised during this assessment included:

- XLVI Electronic Steam Hammer Espresso Coffee Machine
- Tamping tools included: Specialty coffee tamper Eazy Tamp 5 Star Pro Infusion Tamper with Accessories Silver Coffee Distributor 58 mm hard to find with adjustable depth; SUPER HEAVY Coffee Tamper 51mm Stainless Steel Tampa Tamp Espresso Barista
- Puqpress Q2 - Link https://baristatechnology.com.au/products/puqpress-q2

- Integrated Mythos Grinder and Puqpress - https://baristatechnology.com.au/products/integrated-puqpress-m2-mythos-one-grinder-combo
- Social Espresso Café utilised different equipment and layout, including the Puqpress Q2

In addition to the assessment carried out at Barista Technology Australia site, two separate baristas working at Social Espresso Café were also interviewed and observed during coffee making process, with particular focus on the details and postures involved in the tamping process. Photographs and videos were taken on site and used for analysis and comparison purposes. It is also worth noting that a Puqpress machine is utilised for the majority of tamping at that café to eliminate the requirement of manual tamping. Staff reported that they are only required to manually tamp at the end of shift during cleaning activities, and both staff reported experiencing fatigue and pain at times from even short durations of manually tamping during coffee making.

Prior to the physical assessment, review of previous assessments, reports, data and information provided was conducted off site.

Staff and management at Barista Technology Australia were interviewed regarding tamping and barista tasks, along with staff at Social Espresso Café.

Physical assessment was carried out of typical barista tasks involved in tamping, and comparative assessment using the Puqpress when tamping:

- video and photography of tasks, equipment and operators
- measurement of the tasks and equipment, dimensions, weights, forces, repetition, operator postures/joint positions/movements
- assessment of all physical demands of the tasks required
- assessment of task design, layout, workflow, duration and other factors necessary
- research of literature and previous ergonomic and/or risk assessments

Analysis of data and assessment of risks was conducted using a variety of ergonomic assessment tools including:

- Ergonomic risk assessment
- 3D Static Strength Prediction Program (University of Michigan)
- MANTRA manual tasks risk assessment
- RULA Rapid Upper Limb Assessment tool

The Ergonomics Survey was structured to consider the following guidelines:

- *Work Health and Safety Act 2011 (Qld);*
- *Work Health and Safety Regulations 2011 (Qld)*
- *Model Work Health and Safety Act 2011 (Worksafe Australia)*
- *Hazardous Manual Tasks Code of Practice 2016, Safe Work Australia*
- *Australian Standard AS/NZS HB 59 - 1994 'Ergonomics - the human factor';*
- *Hazardous Manual Tasks Code of Practice 2011 (Workplace Health and Safety Qld)*

- *Managing the Work Environment and Facilities Code of Practice 2011 (Workplace Health and Safety Qld)*
- *How to Manage Work Health and Safety Risks Code of Practice 2011 (Workplace Health and Safety Qld)*

4.0 Results and Physical Findings

4.1 Overview of Musculoskeletal injury and manual tasks risks

A musculoskeletal disorder (MSD), as defined in the WHS Regulations Queensland [6], means an injury to, or a disease of, the musculoskeletal system, whether occurring suddenly or over time. MSDs may include conditions such as:

- sprains and strains of muscles, ligaments and tendons
- back injuries, including damage to the muscles, tendons, ligaments, spinal discs, nerves, joints and bones
- joint and bone injuries or degeneration, including injuries to the shoulder, elbow, wrist, hip, knee, ankle, hands and feet
- nerve injuries or compression (e.g. carpal tunnel syndrome)
- muscular and vascular disorders as a result of hand-arm vibration
- soft tissue hernias
- chronic pain.

MSDs occur in two ways:

- gradual wear and tear to joints, ligaments, muscles and inter-vertebral discs caused by repeated or continuous use of the same body parts, including static body positions
- sudden damage caused by strenuous activity, or unexpected movements such as when loads being handled move or change position suddenly.

Injuries can also occur due to a combination of these mechanisms, for example, body tissue that has been weakened by cumulative damage may be vulnerable to sudden injury by lower forces.

What are hazardous manual tasks?

Hazardous manual tasks require a person to lift, lower, push, pull, carry, move, hold or restrain a person, animal or thing. Hazardous manual tasks involve one or more of the following:

- repetitive or sustained force
- high or sudden force
- repetitive movement
- sustained or awkward posture
- exposure to vibration

Hazardous manual tasks can contribute to musculoskeletal injuries, which can be permanent and impact not only on a person's working ability and quality of life, but also on the productivity and economic performance of the company that employs them. Musculoskeletal injuries include:

- muscle strains and sprains
- ligament or tendon rupture
- prolapsed intervertebral discs
- tendonitis of the shoulders and elbows
- carpal tunnel syndrome

The tasks in and nature of the duties involved in coffee making, particularly in the tamping process as assessed in this study reveal that there are many components to the process that may significantly, over time, gradually contribute to pain of the low back and/or shoulder arm and wrist regions in baristas.

4.2 Workstation and equipment design

Design of workbenches and workstation layout contributes largely to the user techniques and postures adopted in the process of making or creating a coffee. There are many components to this process, tools utilised, equipment and many variances in the design and layout chosen by each café owner. Not all of these components will be discussed in this study which is focussed primarily on tamping, in order to compare manual tamping with the alternative use of a Puqpress.

Design of the bench height has a significant impact on the resultant user or operators positioning and postures whilst performing grinding, tamping and other tasks involved. There are restraints on the design of bench heights such as the positioning of the milk fridge underneath the bench which was reported to average 850mm height, therefore the industry average bench height was reported to be between 900mm to 950mm.

The workbench utilised in this study was 940mm height. Anthropometry is the science that deals with the size and shape of people within a population. We can compare the bench and working heights to the elbow and hip heights of a population in order to assess the postural impact on operators and to design better work places.

According to anthropometric data for British adults from SAA HB59-1994 (Ergonomics – The human factor) [7], the 50th percentile male elbow height when standing is approximately 1090mm and for females is 1005mm. When holding the coffee tamper (height of 100 to 110mm) in the dominant hand to exert force downwards into the group handle (held by the opposite hand), the hand/wrist is approximately 1050mm from floor level (940mm bench plus tamper 110mm).

Therefore the dominant hand and arm are exerting force downwards through the tamper at approximately elbow height (just below for the average height male), or 50mm above elbow height for the average female (wearing flat shoes). If the 5th percentile figures were used, both males and females would be working above elbow height and females up to 120mm above (elbow height 930mm). This type of strenuous action, performed at this height often results in compensatory postures of the upper arm, shoulder and trunk. This is to accommodate for the high range of work and exertion of moderate to high downward forces.

Photos 2 & 3: Awkward operator body postures

The Hazardous Manaul Tasks Code of Practice (2016 Safework Australia) states that tasks requiring considerable muscular effort or use of the body for leverage, for example, drilling at a workbench, should be performed at **hip height and no higher**. Tamping of coffee falls into this category and is therefore recommended that this should be performed at or around hip height.

The forces exerted by an operator during tamping (approximately 15kg average force) require considerable muscular effort and are performed at or above elbow height by the hands/wrists due the height of the benches and positioning of the group handle and tamper during tamping. This results in awkward and potential hazardous movements, postures and forces being exerted such as:

- wrist deviation, flexion, rotation and hand postures when holding the tamper and exerting downwards force via the handle (this varied significantly between operators depending on their upper arm posture, ranging from close to neutral wrist positions to extreme ulna deviation as seen in the photos comparison)
- moderate elbow and upper arm joint postures, exerting force away from the body (winged elbow posture)
- awkward shoulder postures and positions including elevation, forward rotation, scapular protraction (upward rotation)
- lateral bending of the trunk to accommodate for the elevation/rotation of the shoulder
- axial rotation of the trunk to accommodation for positioning of the tamper and the group handle in the opposite hand at bench height (dependant on standing position in relation to bench)

These manual tasks and postures performed during tamping have been found to contribute to musculoskeletal injuries, due to the risks involved in this task including sustained and awkward postures in combination with repetitive and sustained force involved during manual tamping.

Photo 4: Awkward shoulder, elbow and trunk postures during tamping

4.3 Tamping task and process

Tamping is the step in the espresso coffee making process that requires the barista to compress the ground coffee prior to extracting to make a puck of coffee. This has become a very scientific process requiring specific density and therefore pressure to be applied in a particular fashion. There however also involves an element of 'art' with the science with significant variation in the precise processes and style of tamping between baristas. The resultant quality of the espresso-based coffee is dependent on all these science verses art details!

Photos 5,6 & 7: Coffee making process

The workload in a busy café is high and constant throughout the shift, and often the barista is making coffee for most of these shifts. Details of the tasks and process are outlined below:

- up to 400 coffees made per day involving tamping for each espresso extracted
- average working shift is 4 to 6 hours for baristas
- pressure or force required for tamping is 30lb or approximately 15kg recommended downwards force through the tamper (varies with individual preference, training and other factors)
- cycle time involved in tamping is between 3 to 5 seconds average
- cycle time involved in making a coffee varies and was found to be average 90 seconds (1.5 minutes) for two coffees (often made at the same time)

Photo 8: Puqpress tamping

Utilising the Puqpress (see Photo 8) changes the workflow for the barista to eliminate the manual tamping process and associated forces exerted, the awkward postures and positions adopted by the operator as well as the numerous benefits of improved quality and accuracy in tamping (refer to video link https://youtu.be/PoXrNPS9lsA).

4.4 Worker/Operator Practices

There are many variables which influence the baristas operating practices, working postures and positions and the resultant potential risks associated with developing musculoskeletal pain or symptoms. As previously mentioned, much discussion and research has been found relating to preventative strategies implemented to reduce the risks of injury and fatigue to baristas. Due to these variables outlined in more detail below, previously implemented risk control measures have fallen short of preventing strain and sprain injuries to baristas. Some examples include:

- Training of baristas in correct operator processes, postures and techniques
- Postures & techniques vary significantly due to individual preferences and styles
- Positioning of group handle
- Stance and foot position (distance from bench; angle and direction of stance to bench and tamping process)
- Tamping process i.e. pressure, force, duration, positioning of body
- Equipment utilised (design and make/model, dimensions of all components)
- Personal techniques (e.g. ‘art’ of coffee making for individual baristas)
- Design of layout of workstation, bench (e.g. height and depth), tamping and operating height and distance
- Workflow design and layout

- Worker adapting compensatory awkward postures and increased force/moments in shoulders and/or back regions to compensate for pain that limits certain postures or forces being exerted

Overall assessment of this process and the research available reveal that postures adopted by baristas throughout the upper limbs, shoulder and back/trunk are frequently awkward and potentially harmful which may contribute to these higher risk working practices.

The hierarchy of control

The Hazardous Manaul Tasks Code of Practice (2016 Safework Australia) outlines the hierarchy of control of risks as summarised below:

> *The ways of controlling the risk of MSDs are ranked from the highest level of protection and reliability to the lowest. This ranking is known as the hierarchy of risk control. The WHS Regulations require duty holders to work through this hierarchy to choose the control that most effectively eliminates or minimises the risk in the circumstances. This may involve a single control measure or a combination of two or more different controls.*
>
> *ELIMINATE THE RISK: The most effective control measure involves eliminating the hazardous manual task and its associated risk.*
>
> *MINIMISE THE RISK: If it is not reasonably practicable to eliminate the risk, then you must minimise the risks so far as is reasonably practicable by:*
>
> *- substituting the hazard with something that gives rise to a lesser risk*
>
> *- isolating the hazard from any person exposed to it*
>
> *- implementing engineering controls.*
>
> *If there is a remaining risk, it must be minimised so far as is reasonably practicable by implementing ADMINISTRATIVE controls, and if a risk still remains, then suitable PERSONAL PROTECTIVE EQUIPMENT must be provided and used. These two types of control measures, when used on their own, tend to be **least effective** in minimising risks because they rely on human behaviour and supervision.*

Existing risk control measures within the food and beverage service industry relating to barista duties have at best been in the 'minimise' category of control, and usually at the lowest levels of administrative or potentially personal protective equipment.

Photo 9: Puqpress tamping with relaxed postures and minimal force exertion

Introduction of the Puqpress to replace manual tamping of coffee has been found to achieve the most effective control measure by eliminating the hazardous manual handling task involved in manual tamping, and the associated risks. Refer to the picture below as a comparison of operator practices using the Puqpress.

5.0 Quantified Risk Assessments Results and Discussion

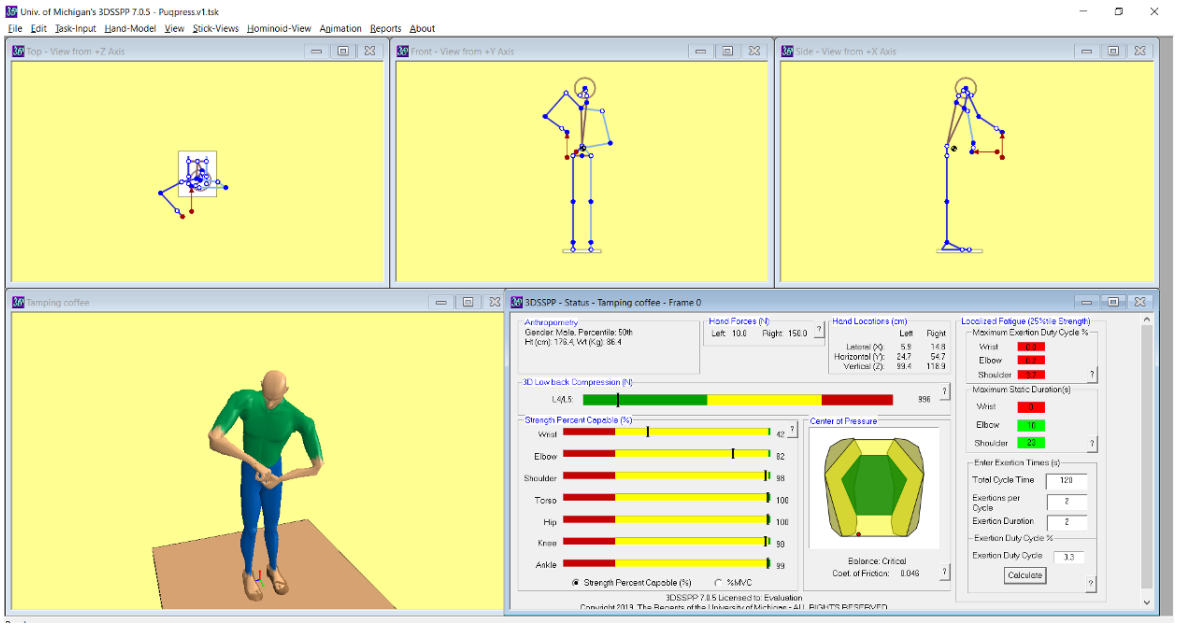
5.1 3D Static Strength Prediction Program

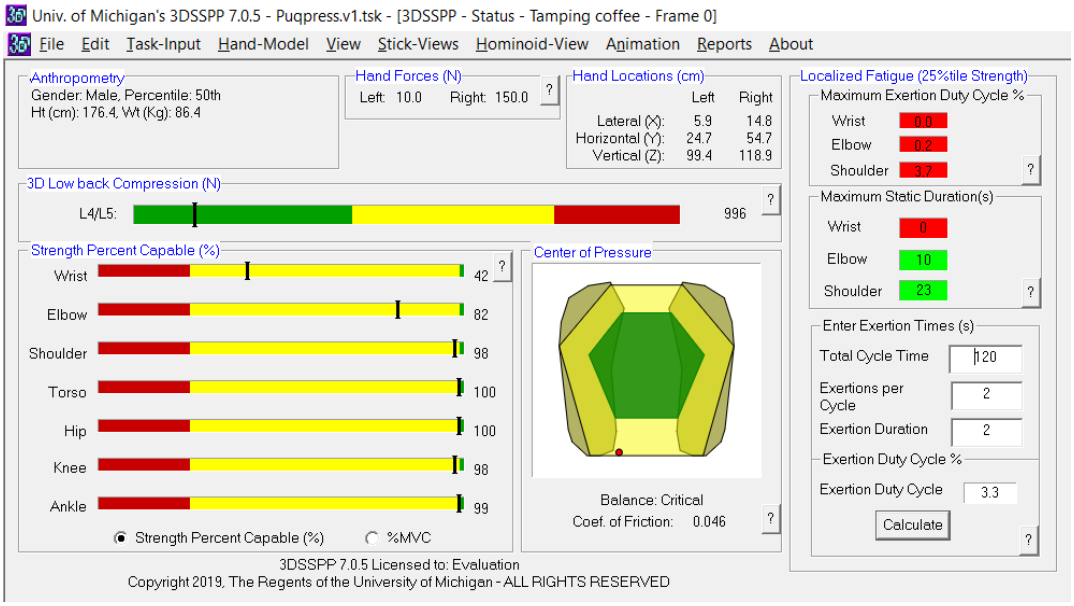
The University of Michigan's 3D Static Strength Prediction Program TM (3DSSPP) was used to analyse the task of tamping as part of the coffee making process. This program can aid the ergonomics analyst as a design and evaluation tool in both proactive and reactive analysis of workplaces and work tasks. It can be a valuable quantitative tool to illustrate the benefits of an ergonomic intervention.

3DSSPP should not be used as the sole determinant of worker strength performance or job designs based on that performance. Other criteria and professional judgment are required to properly design safe and productive jobs.

For this assessment postures were predicted based on the physical assessment findings, photography and video analysis of the tasks assessed. Input data such as forces exerted by each hand (10 Newtons left hand = approximately 1kg; 150 Newtons right hand = approximately 15kg push downward force), predicted joint angles, standing positions, direction of forces and anthropometry (50th percentile of population was used) are entered manually for each task assessed.

Figure 1: 3DSSPP assessment of Tamping Coffee Manually – Male 50th percentile results



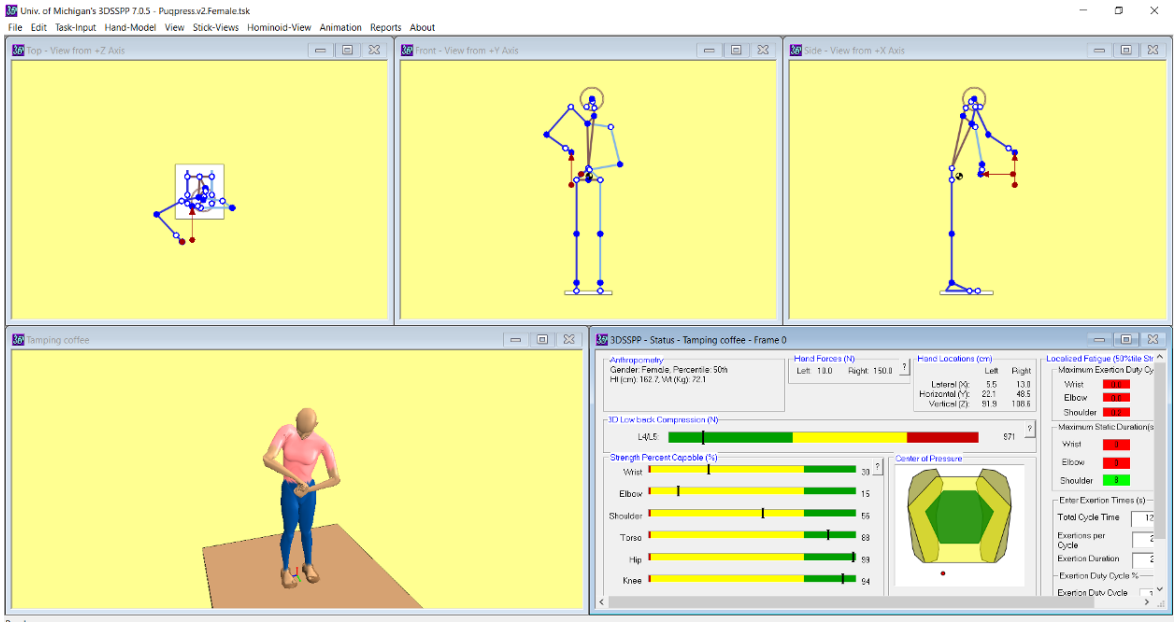


Analysis of manual tamping conducted by an average male exerting approximately 15kg force downwards within the parameters measured and predicted postures/joint angles demonstrated the following results:

- low back compression in the L4/L5 disc is within reasonable limits and in the green (less than 3400 Newtons). Low Back pain is three times more likely in the yellow and ten times more likely in the red (above 6400 Newtons). This does not measure the impact of continuously repeated sub-threshold loading (less than 3400 N) which may in this case contribute to low back pain, or accumulated loading throughout the baristas day.

- The bar graphs indicate that the percentage of the population (50th percentile male) who would be capable of exerting these loads over a shift without fatigue is reduced in particularly for the wrist (42%) and elbow (82%) and slightly for the shoulder region.

Figure 2: 3DSSPP assessment of Tamping Coffee Manually – Female 50th percentile results

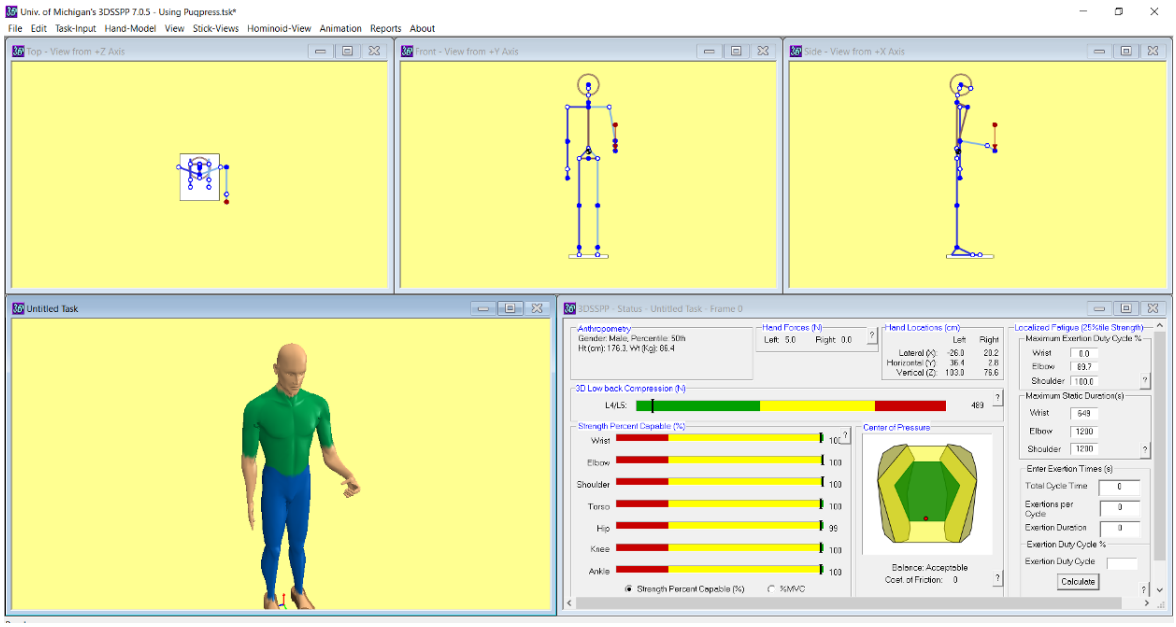


Analysis of manual tamping conducted by an average female exerting approximately 15kg force downwards within the parameters measured and predicted postures/joint angles demonstrated the following results:

- Low back compression in the L4/L5 disc is within reasonable limits and in the green (less than 3400 Newtons). This does not measure the impact of continuously repeated sub-threshold loading (less than 3400 N) which may in this case contribute to low back pain, or accumulated loading throughout the baristas day.

- The bar graphs indicate that the percentage of the population (50th percentile female) who would be capable of exerting these loads over a shift without fatigue. In the case for females the percentage capable is significantly reduced in particularly for the wrist (42%) and elbow (15%), and shoulder (56%).

Figure 3: 3DSSPP Assessment of Tamping Coffee – Using PUQPRESS



Analysis of tamping coffee using the PUQPRESS conducted by an average male requires only very minimal exertion of one hand to hold the group handle while inserting into the Puqpress guides therefore 5N (0.5kg) was entered along with predicted postures/joint angles of neutral standing posture and slight forward reaching:

- low back compression in the L4/L5 disc is very low and within reasonable limits and in the green (less than 3400 Newtons).

- The bar graphs indicate that 100 percent of the population (50th percentile male) would be capable of exerting these loads over a shift without fatigue.

Notes and definitions:

<u>3D Low Back Compression</u>

This is the Low Back compression in the L4/L5 disc and should be in the green (less than 770 pounds or 3400 Newtons). Low Back pain is three times more likely in the yellow and ten times more likely in the red (above 6400 Newtons).

Strength Percent Capable%

These bar graphs indicate the percentage of the population having the current anthropometry, who have enough strength to exert the required load for 5 seconds with at least 2 minutes of rest. The muscles involved should not be fatigued over the length of the shift. If the rest time is less than 2 minutes, then consult the Localized Fatigue analysis.

Localized Fatigue – Maximum Exertion Cycle

These values are the estimated maximum percent duty cycles (exertion time/work time) above which will cause localized fatigue. These estimates are based on the required strength divided by the strength of the population (%maximum voluntary contraction). The percentile of the population strength was set at 50 percent for this assessment.

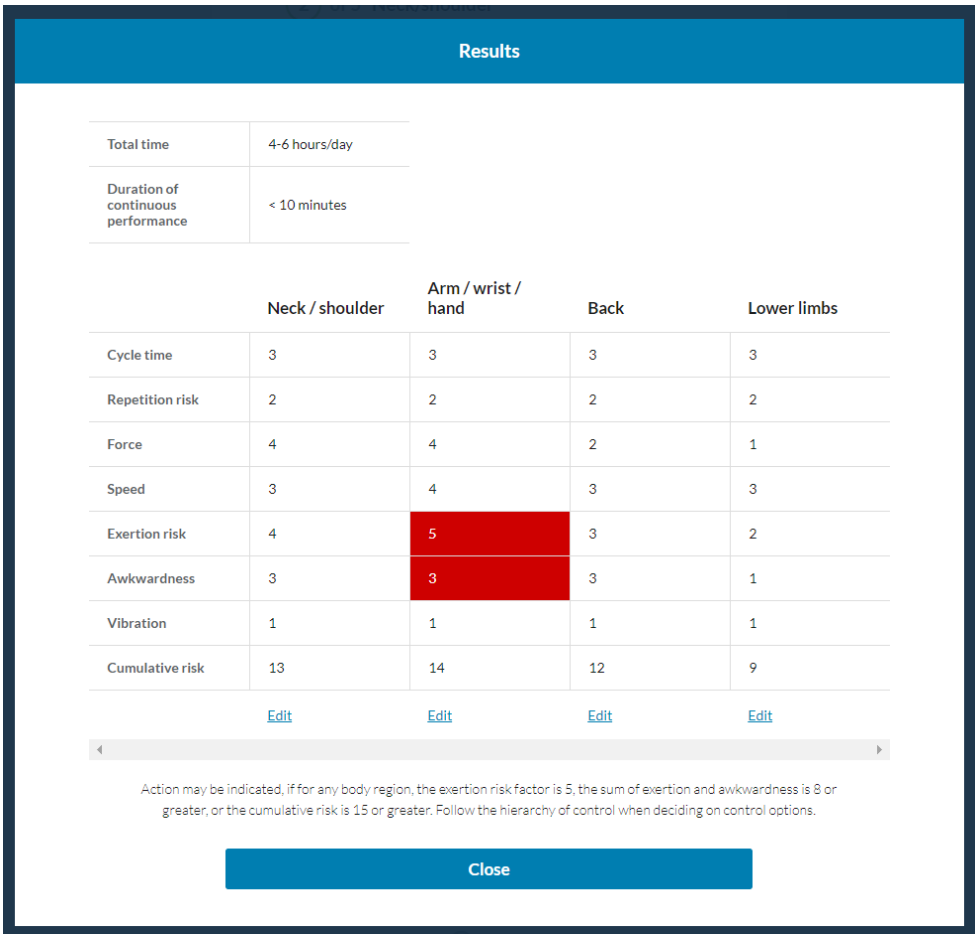
5.2 ManTRA risk assessment

ManTRA is a manual tasks risk assessment tool that was developed by the University of Queensland, Workplace Health and Safety Queensland and the Curtin University of Technology [8]. Data is entered into the assessment tool and this data includes rating the physical risk factors for four body regions (neck/shoulder, arm/wrist/hand, back and lower limbs).

The score for each risk factor is based on the task as a whole and for the person performing the task. The ManTRA eTool automatically combines this data to determine action thresholds for repetition risk, exertion risk and cumulative risk. These action thresholds are presented in the results table (see Figure 4). Further action is suggested if the thresholds are reached or exceeded. For example:

- the exertion risk factor is 5
- the cumulative risk is 15 or greater
- the sum of exertion and awkwardness is 8 or greater.

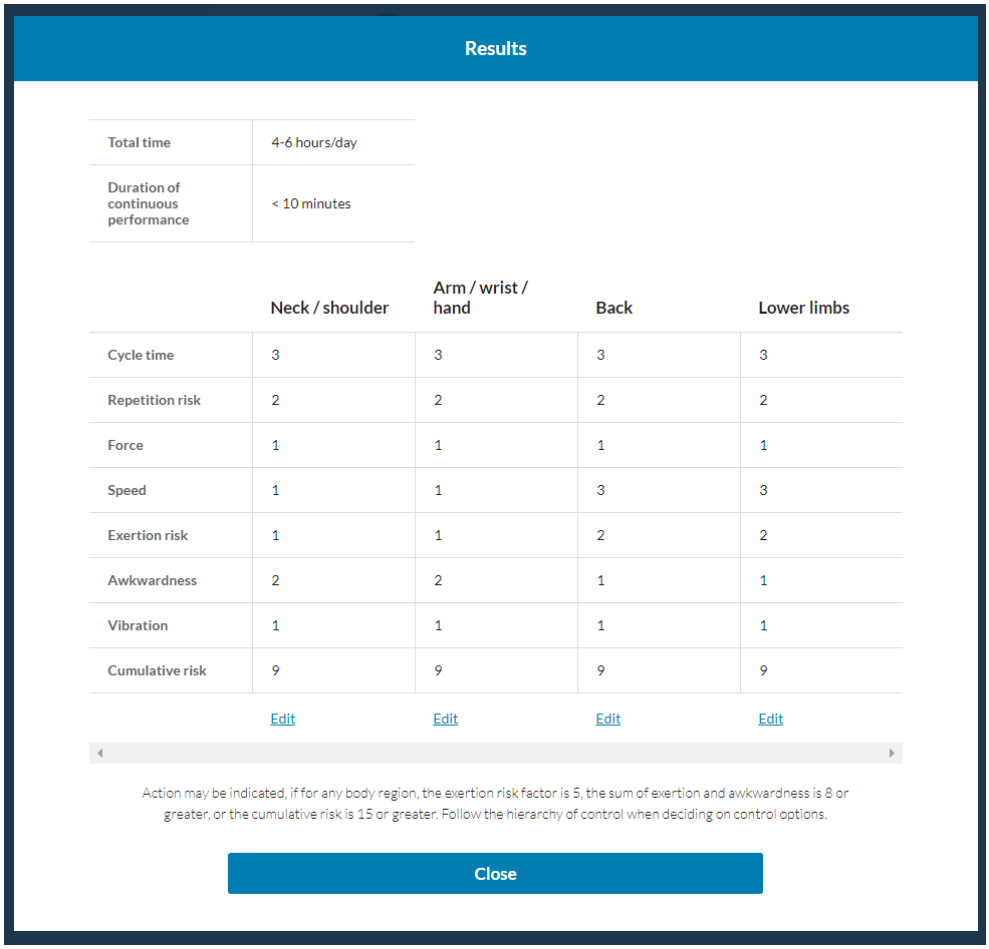
Figure 4: ManTRA risk assessment results – manual tamping coffee



The ManTRA scores as outlined in the results table above for manually tamping coffee indicated that the action thresholds are reached for the Arm/wrist/hand regions and very close to the threshold for the shoulder region. These results would indicate that further action is required to control the risks associated with exertion, awkwardness and the overall cumulative risk.

Variations in the interpretation and assessment data entered may reveal different results from different assessors. Previously conducted assessment on this task using the ManTRA by other health professionals have also indicated similar outcomes.

Figure 5: ManTRA risk assessment results – Using Puqpress



Results of a comparison assessment of the tamping process utilising the Puqpress and data parameters of 'minimal' force, 'slow movements' and only 'moderate deviation in one direction only' for awkwardness revealed significantly lower scores which do not come near any of the action thresholds.

5.3 RULA assessment tool

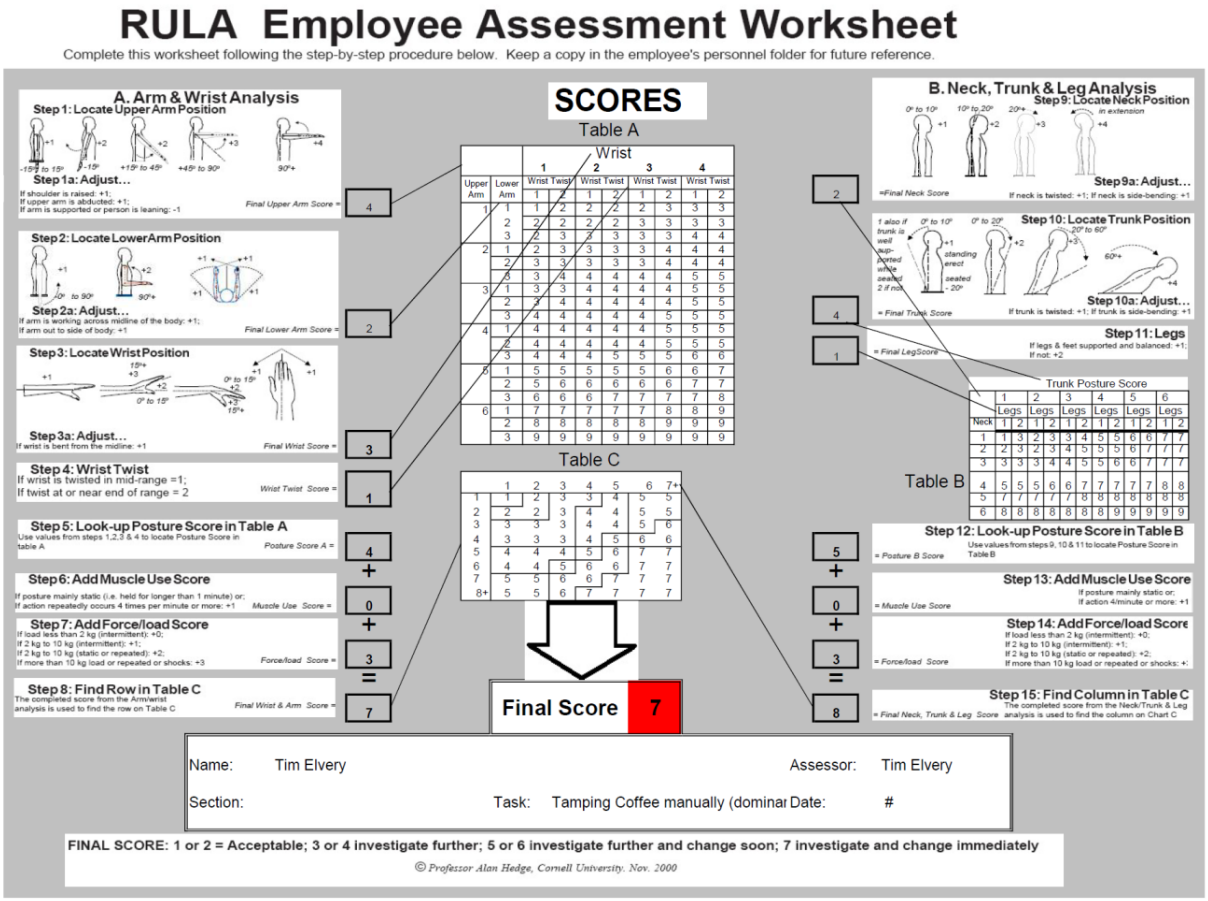
The RULA Assessment Tool was developed to evaluate the exposure of individual workers to ergonomic risk factors associated with upper extremity MSD. The RULA ergonomic assessment tool considers biomechanical and postural load requirements of job tasks/demands on the neck, trunk and upper extremities.

Using the RULA worksheet, a score is assigned for each of the following body regions: upper arm, lower arm, wrist, neck, trunk, and legs. After the data for each region is collected and scored, tables on the form are then used to compile the risk factor variables, generating a single score that represents the level of MSD risk as outlined below:

Score	Level of MSD Risk
1-2	negligible risk, no action required
3-4	low risk, change may be needed
5-6	medium risk, further investigation, change soon
6+	very high risk, implement change now

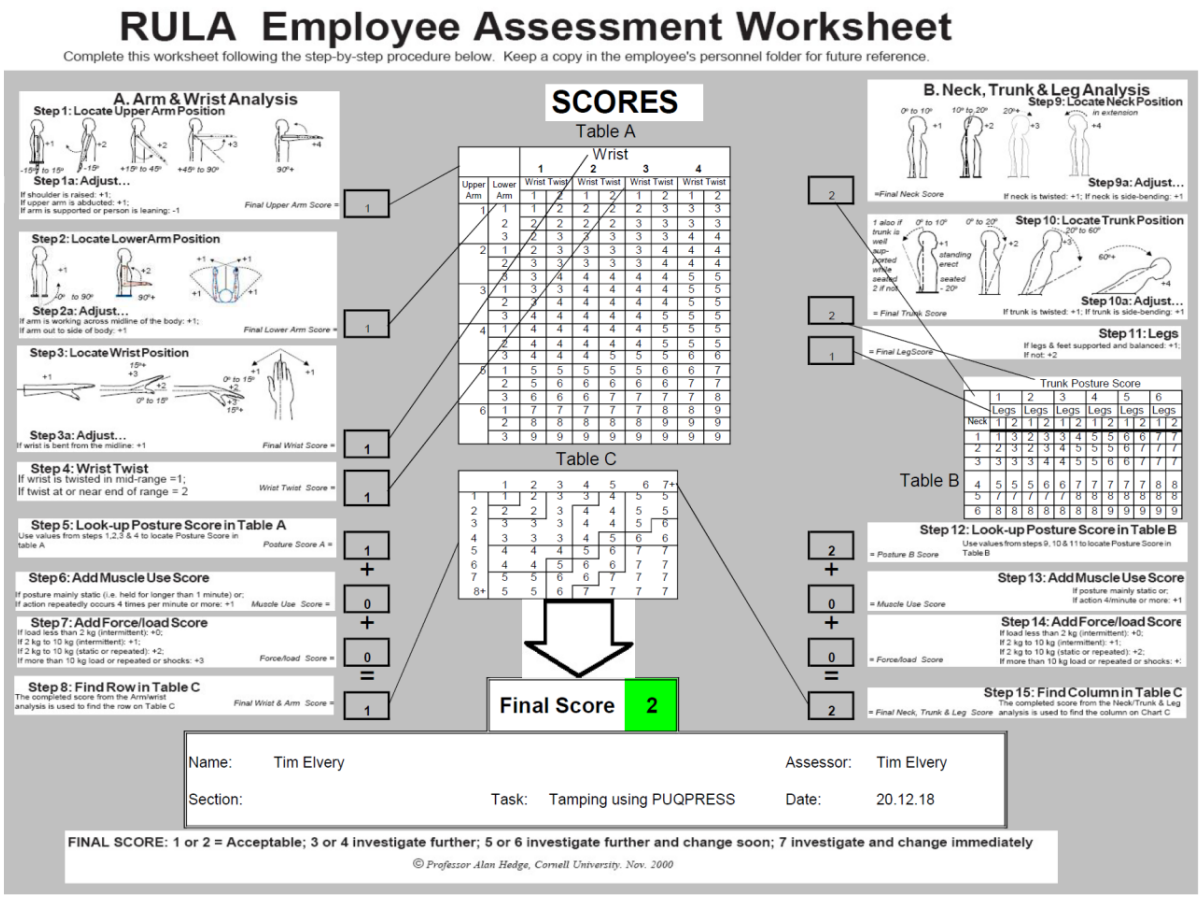
The overall risk score for manual tamping on the RULA assessment was 7 (see figure below) which is in the very high risk range and it recommends investigating and implementing change to reduce the risk.

Figure 6: Tamping coffee manually



When comparing the use of the Puqpress on the RULA assessment, the score of 2 (see figure 7 below) indicates that the risk is negligible and virtually eliminates the risks associated with tamping coffee.

Figure 7: Tamping using Puqpress



6.0 Conclusion

The aim of this study was to assess and identify the factors that may increase the likelihood of developing musculoskeletal injury during manual tamping by baristas. This involved the comparison between manual tamping and use of the Puqpress by baristas.

The results of this study have reinforced the benefits of using the Puqpress in barista tasks for reducing worker fatigue and injury risks.

Through automating the tamping process, Puqpress replaces manual tamping. This achieves the most effective control measure by eliminating the hazardous manual handling task involved in manual tamping, and the associated risks.

Due to the scope of the activity it should not be assumed that all safety measures are covered. Additional measures may be required in particular areas or for exceptional conditions or circumstances.

Thank you for the invitation to conduct this ergonomic risk study for Barista Technology Australia. It was a pleasure to work with all the people involved during the assessment and thank you for your assistance and hospitality.

Yours Faithfully,

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