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Journal of Agromedicine

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/wagr20

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To cite this article: Nicolas Larinier, Nicolas Vuillerme, Alexandre Jadaud, Solène Malherbe & Romain Balaguier (2023): Effects of a warm-up intervention at the workplace on pain, heart rate, work performance and psychological perception among vineyard workers, Journal of Agromedicine, DOI: 10.1080/1059924X.2023.2173690

To link to this article: https://doi.org/10.1080/1059924X.2023.2173690

Published online: 06 Feb 2023.

JOURNAL OF AGROMEDICINE
https://doi.org/10.1080/1059924X.2023.2173690

Effects of a warm-up intervention at the workplace on pain, heart rate, work performance and psychological perception among vineyard workers

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ABSTRACT

Objectives: Warm-up sessions before physical activity are widely used in sports to help prevent injury and improve performance. Nowadays, companies assume that the effects observed in a sport context can be transferred to the workplace, particularly among workers exposed to biomechanical strain. Yet research on the use of warm-up interventions at the workplace is rather scarce and, when available, leads to conflicting results due to the low quality of the studies. To the best of our knowledge, there are no published studies to date assessing the effects of warm-up sessions among vineyard workers. The present study was designed to investigate if and how a single supervised warm-up session could be effective on perceived pain intensity, heart rate, work performance, and psychological perceptions among vineyard workers.

Methods: A total of 31 vineyard workers completed a randomized crossover study at the workplace. They were observed in real work settings, i.e. during the pruning activity. Each participant performed the activity under two conditions: 1) with a warm-up session beforehand (WU) and 2) without any warm-up (NWU). Heart rate (HR) was assessed continuously before and during the warm-up, and during the first hour of pruning. Perceived pain intensity over fifteen anatomical locations was assessed before (T0) and immediately after (T1) warm-up, and after the first hour of work (T2). Readiness to work was assessed at T1. Work performance was assessed in terms of the number of completed tasks (number of pruned vines). Perceived work quality and perceived work ability were assessed at T2.

Results: Perceived pain intensity over the lumbopelvic region was significantly higher at T2 than at T0, and at T2 than at T1, in both WU and NWU. Perceived pain intensity was not significantly different at T2 in WU and NWU. HR at T1 was significantly higher in WU than in NWU. Work performance, readiness to work, and perceived work ability were significantly higher in WU than in NWU.

Conclusion: This study showed that offering vineyard workers a supervised warm-up session at the workplace can lead to promising results where work performance and psychological perception are concerned.

KEYWORDS
Warm-up exercise; workers; pain; vineyard

Introduction

Performing warm-up exercises such as aerobic, dynamic, or stretching exercises before physical activity is common and well-accepted in sports. These exercises aim to prepare and lead the athlete to his physically and psychologically optimal potential to produce the best possible performance with a minimal injury risk[1,2]. The positive effects of warm-up exercises on performance are associated both with biomechanical and physiological responses. Regarding biomechanical responses, warm-ups can decrease the passive resistance of joints and muscles[3]. Regarding physiological responses, numerous studies have demonstrated that warm-ups can increase muscle blood flow by vasodilation[4–6], leading to improved oxidative energy metabolism. Warm-up exercises are also known to have positive effects on muscle injuries[7] as they increase stretching ability and muscle resistance, thus limiting the risk of tearing[7]. Influenced by the positive effects observed in sports, an increasing number of companies are interested in offering warm-ups to their staff before the working day[8–11]. This is especially true for companies exposing workers to physically strenuous jobs and reporting high levels of occupational injuries, like in the agricultural sector. These companies assume that the positive effects observed in the sports context could be transferred to their work context[9,10]. The French health insurance system for agricultural workers (MSA) reported that musculoskeletal disorders were responsible for the

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majority of recognized and compensated occupational diseases in the sector. For instance, in France, in 2016, the MSA reported a total cost of 88,850 229 euros and an average cost of 25,263 euros per sickness leave. Within the agricultural sector, the wine production industry is one of the most affected sectors, accounting for 17.6% of musculoskeletal disorders[12–14]. To the best of our knowledge, only one study to date has assessed the effects of warm-up intervention among vineyard workers[8]. In that study, participants were invited to perform a warm-up session before the working day associated with strength and flexibility exercises at the end of the working day, for 8 consecutive weeks. Even if the intervention led to positive results on pain intensity and physical capacities, a conclusion could not be drawn about the specific effects of the warm-up sessions. In other physically demanding sectors, the analysis of the scientific literature on this topic highlighted a gap between the growing interest of companies in implementing warm-up intervention and their real effects in the workplace: studies reporting the effects of workplace warm-up interventions[15] are scarce, and when available they lead to conflicting results[9–11,16]. Among those studies, the most common type of warm-up implemented at the workplace can be called "hybrid warm-up". It is a combination of 20 dynamic and stretching exercises designed to produce positive effects on several outcomes related to musculoskeletal disorders such as pain, flexibility, strength, and work performance. The warm-up used in the only study among vineyard workers was also a hybrid warm-up, generally performed in 10–15 minutes[8]. In Balaguier's study[8], the hybrid warm-up was associated with strength training. Specific effects of the "hybrid" warm-up intervention were hence never evaluated among vineyard workers. There is therefore a crucial need for additional studies examining the benefits of warm-up interventions delivered in the workplace, particularly in the agricultural sector. The present study aimed to investigate if and how a single supervised warm-up session could be effective on perceived pain intensity, heart rate, work performance, and psychological perception among vineyard workers.

Based upon the effects observed in a sports context and the conflicting results observed at the workplace, it was hypothesized that implementing a warm-up session among vineyard workers could be beneficial on perceived pain intensity[17–19], heart rate[1,20], work performance[1,2] and psychological perception[21–23].

Methods

Study design

A randomized cross-over study[24,25] was implemented from November 2020 to March 2021 among vineyard workers recruited from six wine companies located in the Bordeaux vineyard (France). As most of the measures in the present study are subjective and might have great inter-individual variability, the randomized cross-over design with a self-comparator maximizes statistical power from the sample size[24–26].

Recruitment and flow of participants

The sample size calculation, using an alpha risk of 0.05 and a beta risk of 0.20 with an estimated follow-up loss of 15%, highlighted a need for 30

Figure 1. Cep vine before (A) and after (B) pruning.

Figure 2. Common postures adopted by vineyard worker during pruning.

subjects. Thirty-one vineyard workers volunteered to participate in the study. Inclusion criteria for participation were being aged from 18 to 60 years, presenting no previous surgery in the lumbopelvic region in the last 12 months, working full time, and having at least 1 year of employment in the company[8]. All participants were informed about the purpose and content of the project and gave their written informed consent to participate in the study. The experimental protocol received approval from the ethical committee of the companies, including union representatives. Each volunteer participated in the present study after the completion of a declarative medical questionnaire. Finally, this study was performed following the principles of the Declaration of Helsinki (1975).

Randomization and blinding

The 31 participants performed during one hour the same professional task, pruning vines under two conditions: (1) after a warm-up intervention (WU); (2) without any warm-up intervention (NWU). The order of these two conditions was randomized for each participant.

Participants were not blinded to the intervention as they volunteered to participate and since they were aware of the intervention. The examiners were not blinded to the intervention or outcomes as they were involved in the study design.

Working activity

Pruning: Pruning is a critical component of the grape production system. In France, it takes place during the winter season (generally from November to March). Pruning activity consists in removing some wood from the vine, with a pruning shear, to select the fruiting wood (generally 2 branches in the Bordeaux vineyard) and control the quantity and the quality of the grapes produced (Figure 1A and 1B). Figure 2 illustrates a vineyard worker performing a pruning activity. This activity involves highly repetitive hand cutting and trunk flexion in sustained positions[12,13].

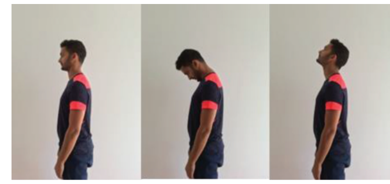
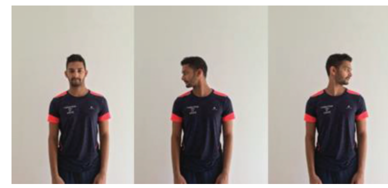
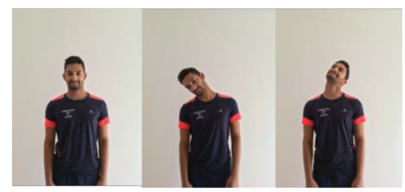
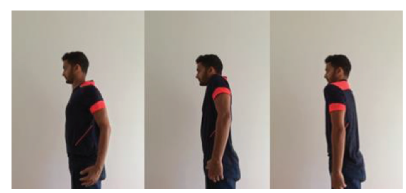
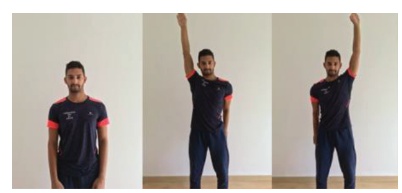
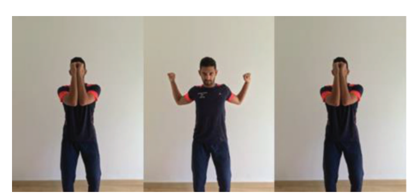
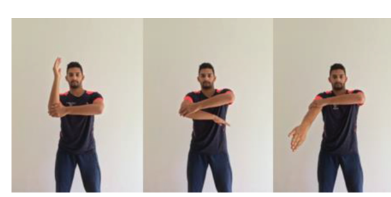
Warm-up intervention

The intervention was a supervised warm-up lasting 15 min and consisted of 22 exercises, presented in Table 1. These exercises were a combination of dynamic exercises and stretching exercises. These exercises are commonly used in studies implementing warm-up interventions at the workplace[9–11,16]. This warm-up aimed to focus on the body regions particularly involved in pruning activity (shoulders, elbows, wrists, upper and lower back). Interestingly, these body regions are also the most concerned by pain and work interruption in this occupation[27,28]. During the warm-up condition, vineyard workers performed the exercises under the supervision of a research team member, graduated with a master of sports science, and specialized in WMSD prevention among vineyard workers. The exercises were performed before the working day (8:00 am), in a standing position, in regular working clothes, and without any props. At the end of the 15 minutes, vineyard workers were invited to start as fast as possible pruning.

Outcome measures

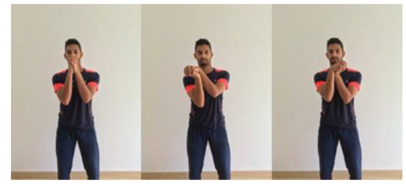
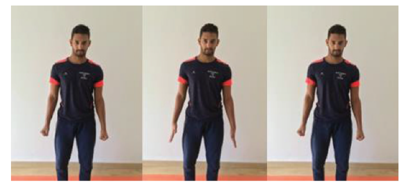
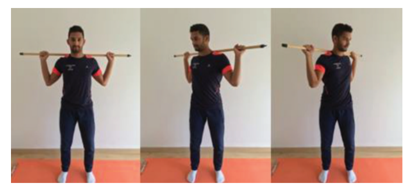
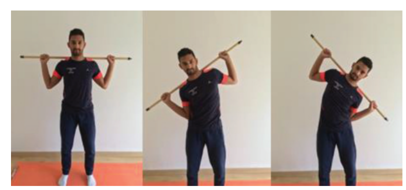
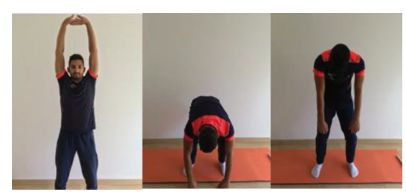
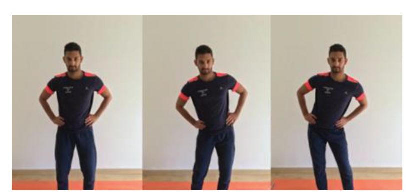
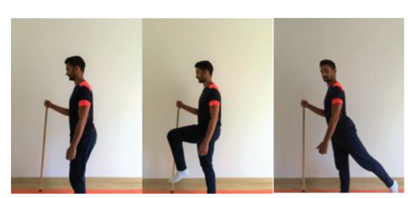
Participants were observed thrice, before (T0), immediately after the WU (i.e. at the beginning

Table 1. List of the exercises included in the warm-up.

Exercise name	Repetitions	Anatomical area	Type of exercise	Pictures
“Yes movement”	10	Neck	Dynamic	
“No movement”	10	Neck	Dynamic	
“Maybe movement”	10	Neck	Dynamic	
“Shoulders roll”	10	Shoulders	Dynamic	
“Arms elevation”	10	Shoulders	Dynamic	
“Butterfly”	10	Shoulders	Dynamic	
“Elbow flexion extension”	10 *2	Elbows	Dynamic	

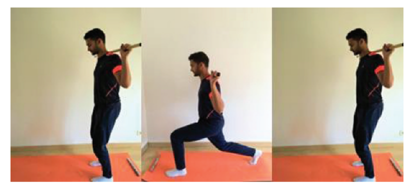
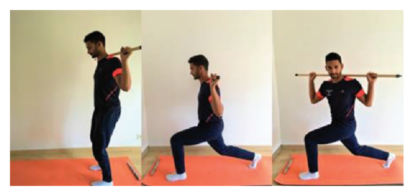
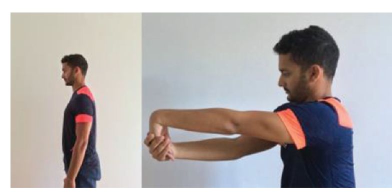
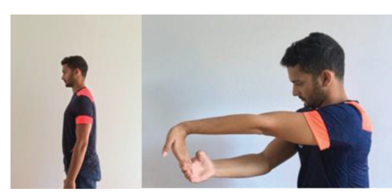
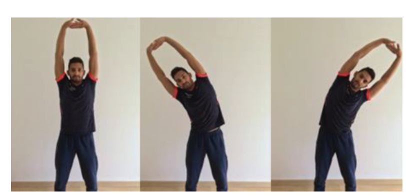
(*Continued*)

Table 1. (Continued).

Exercise name	Repetitions	Anatomical area	Type of exercise	Pictures
"Wrist rotation"	10	Wrists	Dynamic	
"Hand clenching"	10	Fingers	Dynamic	
"Trunk rotations"	10	Trunk	Dynamic	
"Trunk inclinations"	10	Trunk	Dynamic	
"Trunk flexion/extensions"	10	Trunk	Dynamic	
"Pelvic circumduction"	10	Trunk	Dynamic	
"Knee elevation"	10*2	Lower limb	Dynamic	

(*Continued*)

Table 1. (Continued).

Exercise name	Repetitions	Anatomical area	Type of exercise	Pictures
"Lower limb abduction"	10*2	Lower limb	Dynamic	
"Squats"	10	Lower limb	Dynamic	
"Lunges"	10	Lower limb	Dynamic	
"Lunges trunk rotation"	10	Lower limb / Trunk	Dynamic	
"Forearm extensor stretch"	2*10s	Forearm	Stretching	
"Forearm flexor stretch"	2*10s	Forearm	Stretching	
"Trunk lateral stretch"	2*10s	Trunk	Stretching	

(*Continued*)

Table 1. (Continued).

Exercise name	Repetitions	Anatomical area	Type of exercise	Pictures
"Trunk axial stretch"	2*10s	Trunk / Lower limb	Stretching	

of the working day) for the NWU (T1), and at the end of the first hour of work (T2).

Perceived pain intensity

Pain intensity was rated respectively for the last 3 months[29], at (T0), (T1), and (T2). The pain intensity for the last 3 months was collected retrospectively. Participants had to rate their pain intensity using a 0–10 numerical rating scale (NRS), where 0 was used to indicate "no pain" while 10 indicated the "worst possible pain"[26,30]. Based on the study of Kuorinka and colleagues[31], fifteen anatomical locations were asked: neck, left shoulder, right shoulder, left elbow, right elbow, upper back, lower back, left wrist/hand, right wrist/hand, left hip/thigh, right hip/thigh, left knee, right knee, left ankle/foot, right ankle/foot.

Heart rate

Each vineyard worker was equipped with a heart rate (HR) monitor placed on the wrist[32,33]. In the present study, the monitor was a Geonaute Onmove 500. Participants could place the monitor on the arm they wanted to prevent any discomfort due to the bracelet during the working task. The HR was continuously recorded during the entire duration of the supervised warm-up. Then, during both control and experimental conditions, HR was recorded between T1 and T2. For the statistical analysis, HR data was analyzed in original units (beats per minute [bpm]). The mean value of the first minute of recording was saved for T0[34]. For T1, the mean value of the 15 minutes of the warm-up was retained[35]. For T2, the mean value of the last 15 min was calculated.

Work performance

To assess work performance, the number of grapevines pruned during one hour was recorded by a research team member.

Readiness to work

Readiness to work was rated subjectively using a 0–10 numerical rating scale, where 0 was used to indicate "not at all ready" and 10 "perfectly ready to work". This scale was adapted from the scale of readiness to play a match, used in different team sports such as football (soccer) or handball[21,22]. Readiness to work was asked just before the beginning of the working activity.

Perceived work quality

Perceived work quality was rated subjectively by the worker using a 0–10 numerical rating scale, where 0 was used to indicate "worst performance" and 10 "best performance"[23,36,37]. This scale was used for example in a sport context, in studies with golfers, who rated their perceived shot quality[23,36]. Perceived work quality was measured at T2, just after the end of the first hour of the working day, during the two conditions.

Perceived work ability

The work ability was rated subjectively using a 0–10 numerical rating scale, where 0 was used to indicate "worst work ability ever" and 10 "best work ability ever". This scale is a single item from the original Work Ability Index[38,39].

Table 2. Time of measurement for each outcome.

Outcomes	T0 Before Warm-up	T1 After Warm-up Or at the beginning of the working day for NWU	T2 T1 + 60min
Perceived pain intensity	X	X	X
Heart rate	X	X	X
Work performance			X
Readiness to work		X	
Perceived work quality			X
Perceived work ability			X

Time of measurement

The time of measurement for each outcome is presented in Table 2.

Statistical analysis

Descriptive statistics were calculated to provide a summary of the demographic characteristics of vineyard workers. All results are presented as mean and standard deviation. Normal distribution according to the Shapiro-Wilk test was assessed. As data did not follow a normal distribution, changes caused by the warm-up intervention were assessed using Wilcoxon signed-rank test. The significance level was set at 0.05 for all statistical analyses.

Results

Participants' characteristics

Participants' characteristics are presented in Table 3. Thirty-one participants volunteered to participate in this study (15 men and 16 women). Participants perceived pain intensities during the last 3 months preceding experimentation are presented in Table 4. Over the 15 anatomical locations assessed for perceived pain intensity during the last 3 months, values over 1.5 on a 10-point scale were observed for the lumbopelvic region.

Table 3. Participants' characteristics.

Demographics	
Male	15
Female	16
Age (years)	40.1 (±10.6)
<30	23%
30–39	23%
40–49	35%
50 or more	19%
Height (cm)	167.6 (±8.5)
Body mass (kg)	70.8 (±13.6)
BMI (kg/m2)	25.2
Seniority (years)	14.3 (±10.2)

Table 4. Participants' perceived pain intensity during the last 3 months.

Pain Locations	Perceived pain intensity during the last 3 months Mean ± standard deviation
1. Neck	0.07 ± 0.46
2. Left Shoulder	0.14 ± 0.68
3. Right Shoulder	0.26 ± 0.95
4. Left Elbow	0.30 ± 1.12
5. Right Elbow	0.30 ± 1.12
6. Upper Back	0.00 ± 0.00
7. Lower Back	1.63 ± 2.50
8. Left Wrist/Hand	0.45 ± 1.22
9. Right Wrist/ Hand	0.53 ± 1.33
10. Left hip/thigh	0.00 ± 0.00
11. Right hip/thigh	0.00 ± 0.00
12. Left Knee	0.23 ± 1.52
13. Right Knee	0.09 ± 0.61
14. Left Ankle/Foot	0.00 ± 0.00
15. Right Ankle/ Foot	0.00 ± 0.00

Perceived pain intensity

At T0, the mean intensity was 0 for all anatomical locations except for the lumbopelvic region (0.58 ± 1.65). Then, over the 15 anatomical locations assessed for pain intensity, significant changes were observed for the lumbopelvic region. For this anatomical location, pain intensities are presented in Figure 3. Pain intensity significantly increased in the NWU condition between T1 and T2 (0.94 ± 2.26 vs 1.97 ± 3.20; $p < .01$). In the WU condition, pain intensity did not increase between T0 and T1 (0.58 ± 1.65 vs 0.48 ± 1.43), but increased between T0 and T2 (0.58 ± 1.65 vs 1.42 ± 2.66; $p < .05$) and T1 and T2 (0.48 ± 1.43 vs 1.42 ± 2.66; $p < .05$) for the lumbopelvic region.

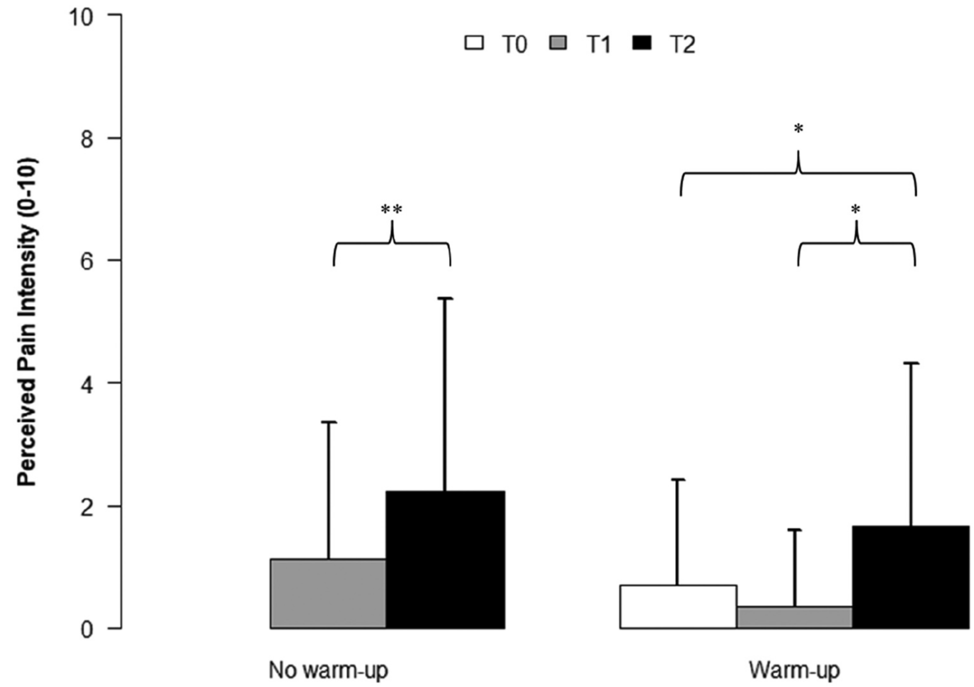


Figure 3. Perceived pain intensity over the low back according to the time of measurement T0, T1, T2.

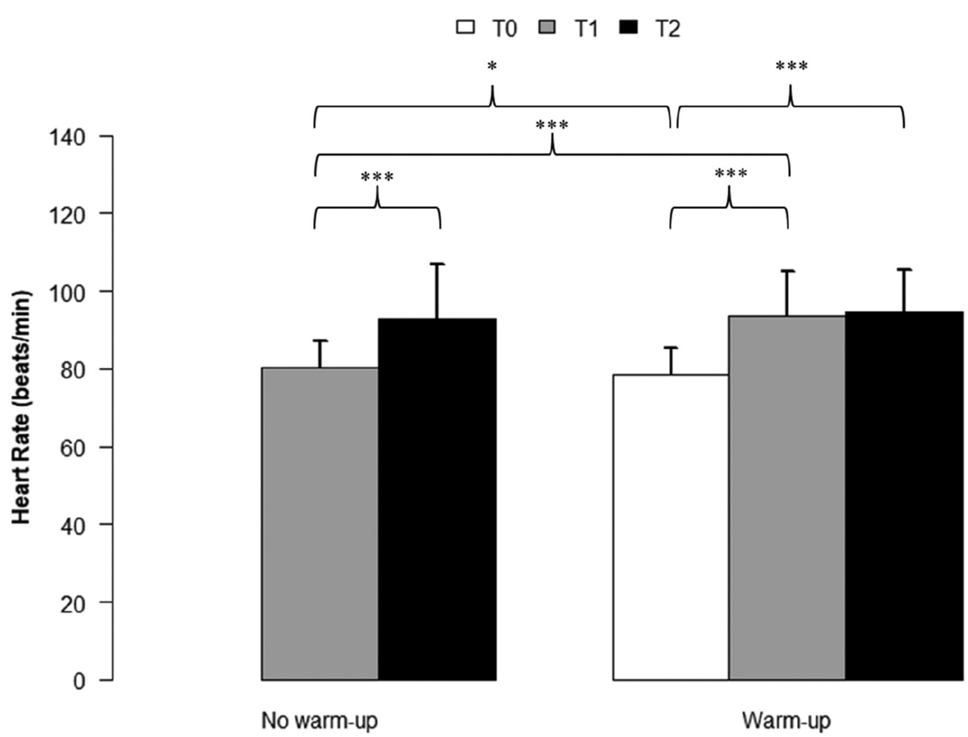


Figure 4. Heart rate in beat per minute (bpm) at T0, T1 and T2 during pruning.

Heart rate

Heart rates are presented in Figure 4. HR increased significantly during warm-up, between T0_WU and T1_WU (78.51 ± 6.75 vs 93.70 ± 11.26; $p < .001$), and the difference between T1_WU and T1_NWU (93.70 ± 11.26 vs 80.23 ± 6.81; $p < .001$) was significant. The difference

Table 5. Readiness to work at T1, Work performance, Perceived work quality and Perceived work ability at T2.

Work Performance			Readiness to Work			Perceived Work Quality			Perceived Work Ability		
WU mean (sd)	NWU mean (sd)	p-value	WU mean (sd)	NWU mean (sd)	p-value	WU mean (sd)	NWU mean (sd)	p-value	WU mean (sd)	NWU mean (sd)	p-value
183.50 (90.71)	172.20 (87.90)	0.029 *	8.55 (1.66)	7.58 (1.63)	0.007 **	8.31 (1.27)	8.16 (1.24)	0,509	8.39 (1.43)	7.71 (1.29)	0,018 *

between T0_WU and T1_NWU was also significant (78.51 ± 6.75 vs 80.23 ± 6.81; $p < .05$). The difference between T0_WU and T2_WU (78.51 ± 6.75 vs 94.70 ± 10.60 $p < .001$) and the difference between T1_NWU and T2_NWU (80.23 ± 6.81 vs 93.07 ± 13.65 $p < .01$) were significant.

Readiness to work

Results of the readiness to work are presented in Table 5. The mean readiness to work was significantly higher ($p < .01$) in the WU condition (8.55 ± 1.66 vs 7.58 ± 1.63) than in NWU.

Work performance

Results of the work performance are presented in Table 5. The mean work performance was significantly higher in the WU condition than in NWU (183.50 ± 90.71 vs 172.20 ± 87.90 pruned vines; $p < .05$).

Perceived work quality

Results of the perceived work quality are presented in Table 5. For the perceived work quality, the difference between the two conditions was not significant (8.31 ± 1.27 vs 8.16 ± 1.24).

Perceived work ability

Results of the perceived work ability are presented in Table 5. For the perceived work ability the difference between the two conditions was significant (8.39 ± 1.43 vs 7.71 ± 1.29; $p < .05$).

Discussion

Over the past decade, numerous studies have examined the benefits of physical activity intervention at the workplace[40–43]. These studies provide evidence of the potential of these interventions in reducing pain intensity and musculoskeletal disorders. Such results encourage companies and scientists to design and implement new protocols to further improve workplace physical activity intervention's effectiveness. Workplace warm-up interventions offer major advantages for companies as they do not take much time (<15 min) and can be performed in a standing position at the workstation, without any special equipment, and with the employees wearing their usual work clothes. However, there is a gap between the benefits observed in sports and the number of published studies that have assessed such effects at the workplace. The present study examined the effects that a worksite warm-up session performed by 31 vineyard workers produced on perceived pain intensity, heart rate, work performance, readiness to work, and perceived work ability during the first hour of pruning.

Our results showed that pruning activity performed by vineyard workers increased heart rate over the first hour of work. In the NWU condition, heart rate significantly increased by approximately 10% (80.23 ± 6.81 at T1_NWU vs 93.07 ± 13.65 at T2_NWU; $p < .001$). We can hypothesize this cardiovascular change is more specifically an increase in muscle blood flow and muscle oxygen consumption, i.e. an increase in energy metabolism[20]. Interestingly, the 15 minutes warm-up intervention allows vineyard workers to reach the same heart-rate value as the mean value over the first hour of pruning (93.70 ± 11.26 at T0_WU vs 94.70 ± 10.60 at T2_WU). Some studies have reported that the improvement of oxidative energy metabolism, i.e. increasing muscle blood flow by vasodilation, could improve performance[4–6]. In this study, such a conclusion is further supported by the significant increase in the number of vines pruned between the NWU and WU conditions: vineyard workers pruned 11.3 more vines in one hour (183.50 ± 90.71 vs 172.20 ± 87.90) after the 15-minute warm-up session than without the warm-up, which corresponds to a 6.6% increase in work performance. A rapid calculation shows that without warm-up, vineyard workers pruned approximately 43 vines (versus 46 with the warm-up) every 15 minutes. Keeping in mind that the effectiveness of workplace physical activity interventions increases when interventions are planned during working hours[44,45], our results suggest that after one hour of pruning following warm-up, ¼ of the time needed to perform warm-up was recovered. Therefore, further investigations are needed to confirm, as put forward by our results, that the time needed to perform exercises may have no impact on productivity after 4 hours of work. On the one hand, this difference regarding work performance may stem from the capacity of the warm-up session to prepare the oxidative energy metabolism for the work activity. On the other hand, this difference may also be explained by a biomechanical phenomenon often described in sports, i.e. a decrease in the passive resistance of joints and muscles induced by the warm-up session. This potential decrease in passive resistance of joints and muscles could also be related to the higher work ability reported in the warm-up condition (8.39 ± 1.43 vs 7.71 ± 1.29; $p < .05$). Further studies on workplace warm-up intervention are therefore needed to assess the effects on muscle stiffness using specific tests such as the "back scratch test" for shoulder flexibility[46] or the "finger to floor test" for back and hamstrings flexibility[47]. These results could also be related to positive effects observed for readiness to work. Interestingly, the readiness to work was higher (i.e. better) in the warm-up condition (8.55 ± 1.66 vs 7.58 ± 1.63 $p < .01$) which means workers seemed to feel more confident and more comfortable beginning the working activity after a WU.

Increased productivity, i.e. in this case increased work performance, suggests that the duration of the warm-up was appropriate[20]. In a review published in 2003 in which the effects of warm-ups on sports' performance were reported[20], Bishop pinpointed that the warm-up session should be of sufficient duration to maximize performance. In cases where the activity is to be carried on over several hours, the warm-up should last at least 10 minutes to enhance performance[20]. That duration was applied in the few studies which assessed the effects of a warm-up intervention at the workplace[9,16]. However, in her review of 2015[1] on warm-up strategies for sports, McGowan recommended a 15-minute warm-up at an intensity of 60–70% VO2max, to improve the range of motion (ROM). The warm-up duration applied for this study was therefore longer than the ones used in other occupational settings but seems more in line with sports recommendations[1,20]. Bishop[20,48] and Woods et al[7] also highlighted that the optimal warm-up intensity seemed to be 60% VO2 max (maximal oxygen consumption). Such intensity could maximize the benefits on performance while causing minimal fatigue (i.e. minimal decrease in muscle glycogen)[20]. VO2 was not evaluated directly in this study due to the complexity of the required set-up in a workplace context. However, VO2 max and heart rate are linked, as suggested by Karvonen[48–50]. In the present study, the heart rate increase induced by the warm-up did not seem sufficient to reach a level close to 60% VO2 max. Nevertheless, this WU intervention seemed to increase the heart rate to a level similar to the one reached during the work task. The warm-up intervention could therefore be considered suitable for the working activity in terms of intensity[20].

Secondly, our results suggest that, despite increasing productivity, a WU session does not increase participants' pain perceived intensity more than after one hour of pruning without warm-up. Of note, during both conditions (NWU, WU) and over the lumbopelvic region, one hour of pruning activity significantly increased pain intensity by one point to reach similar levels (WU: 1.42 ± 2.66; NWU: 1.97 ± 3.20, $p > .05$). What is surprising in this result is that a reduction in pain intensity was expected during the WU condition. On the one hand, this result may be explained by the characteristics of the vineyard workers. In this study, pain intensity reported by the participants over the last 3 months was low (<1 on a 0–10 scale). Bayattork and colleagues[51] defined such pain intensity as "no or little pain". With an average age of 40.9 (±10.4

years), the vineyard workers who participated in this study can be considered relatively young compared to another reference cross-sectional study implemented among vineyard workers[27]. For example, 23% of the vineyard workers in our study were<30 while this age group represents 12.5% in the study of Bernard and colleagues[27]. On the other hand, the increase in pain intensity during the first hour following the WU may also be explained by work performance. Higher work performance leads to an increase in the exposition to biomechanical risk factors of pain such as repetitiveness or awkward postures.

Finally, regarding perceived work quality, no significant differences were observed between the two conditions (8.31 ± 1.27 in WU vs 8.16 ± 1.24 in NWU). This result suggests that the increased productivity in the WU condition did not lead to a reduction in work quality during one hour of pruning. Nevertheless, such a result should be taken with caution since work quality was assessed using self-reporting scales. As work quality is part of the vineyard workers' assessment and is directly related to their wages, they are unwilling to lower their self-reported work quality rating[23]. To analyze work quality more objectively, a supervisor should be asked to assess the vineyard workers' work quality. In a workplace context, assessors are often asked to make a judgment on a rating scale about the quality of the work they evaluate[52]. It seems important not to underestimate the environmental risk factor as tasks related to vine growing are processed outside, which means that the weather or the terrain can have an impact on perceived work quality[53]. Furthermore, as the level of work quality in the NWU condition was high (8.16 ± 1.24), the possibility of being positively affected by the WU was reduced, particularly due to a potential ceiling effect.

Strengths

The design of this study can be considered a strength. Indeed, randomized cross-over design (1) eliminates between-subject variability[54], (2) is appropriate when the effects of treatment are short-lived and reversible[54], and (3) is also best suited to trials related to chronic conditions or diseases[54]. Participants completed their usual work, subject to common adverse events in that sector (weather, work organization, tool failure)[53] which increased external validity. Qualified trainers supervised the WU for all participants. Strong indications of higher effectiveness of supervised vs unsupervised training have been reported by Coury and colleagues[42]. Moreover, Dalager and colleagues[55] highlighted the role of supervision in maintaining participants in a physical activity program. This point is particularly relevant in the case of warm-up interventions, for which dropout rates are close to 20%[9,10] in studies without trainer supervision.

Limitations

The major limitation of this study is related to the fact that its results are based on the implementation of a single warm-up session, which limits the possibility of examining long-term effects at 6 or 12 months. Interestingly, warm-up interventions implemented at the workplace usually last from 6 to 12 weeks[9–11,16], whereas in the sport context it is common to evaluate the immediate effects of warm-ups. It is important to note that this study could be considered a pilot study as it was the first one assessing WU effects in the workplace among vineyard workers. Another limitation is the use of subjective outcomes, as participants were asked to rate pain intensity, readiness to work, work ability, and work quality on a 0–10 scale. However, such outcomes are often used in the workplace context, where they are considered practical and reliable[56].

Implications for practice

Warm-up sessions at the workplace showed promising results for vineyard workers. In this study, a warm-up performed before work led to higher work performance without an increase in perceived pain intensity. These findings can be considered an encouraging starting point to implement such interventions in wine companies.

Implications for future research

To identify the effects on perceived pain intensity, future studies on supervised workplace warm-ups should focus on workers who experience pain. In a case of a sample with moderate to high pain levels at baseline, the implemented warm-up should be more focused on pain symptoms (i.e. stretching exercises)[57,58]. Furthermore, pain among vineyard workers is related to the cumulative load and the repetitiveness of the tasks. Observing an increase in perceived pain intensity during the entire working day is likely. Thus, a difference in perceived pain intensity between NWU and WU conditions could be more important after several hours of work. In this study, the warm-up led to an increase in HR to a level similar to the one reached during the work activity. However, it was a level far lower than the literature recommendations regarding warm-up intensity. Future research should implement a more intensive warm-up intervention. It would be interesting in future studies to explore physiological outcomes more precisely to confirm whether or not such warm-ups can prepare the metabolic and cardiovascular systems for the working day. Efforts should be made in a potential future study to assess more objective outcomes for pain as well as physical and psychological capacities. From this perspective, pressure algometry could be an interesting tool to assess musculoskeletal pain in a semi-objective way[59]. This method is commonly used by clinicians and researchers to assess pain sensitivity as an outcome of physical activity[17,60]. Nevertheless, pressure pain threshold assessment could be difficult to set up in a workplace context, particularly in the agricultural sector. As these results are promising concerning work performance, perceived pain intensity, and work ability for the first hour of pruning, it should be interesting to assess if these effects last during an entire working day.

Conclusion

This study has demonstrated that offering vineyard workers a supervised warm-up session leads to promising results on work performance and psychological perception. Future research should implement such interventions on a more representative sample of vineyard workers regarding pain levels.

Acknowledgments

Authors are grateful to the vineyard-workers and to the direction of the Château Beychevelle, the Château Camensac, the Château Clarke, the Château Haut-Bages Libéral, the Château Palmer and the Vignobles de Larose for their active participation in this study.

Disclosure statement

All authors are memberships of Opti'Mouv, a company that provides workplace health promotion services as workplace physical activity programs.

Funding

This study is part of the PhD thesis of the first author Nicolas Larinier. The PhD thesis is promoted by the University of Grenoble Alpes and partially financed by the "Ministère de l'Enseignement Supérieur et de la Recherche" via the "Association Nationale Recherche Technologie" (ANRT) by means of the "Convention Industrielle de Formation par la Recherche" (CIFRE) grant (n° 2019/0488) with the Opti'Mouv company. The founding source has no role in the study design, data collection, results interpretation or manuscript writing.

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