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Effect of a Single Dose of Analgesic on Headache Severity in an Australian Population. A Quasi-Experimental Study

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Abstract

Background: Headache is a widespread neurological condition in the world with a massive impact on daily functioning, productivity, and quality of life. The major subtypes of headaches, such as tension-type and migraine, display different levels and are usually triggered by stress, sleep deprivation, and environmental conditions. Paracetamol happens to be one of the most common analgesics to relieve acute headaches since it is safe and readily available.

Purpose: The purpose of the study was to determine the effectiveness of a single 500 mg dose of paracetamol in lowering the severity of headaches in the Australian community.

Methods: A pre-and and post-quasi-experimental design was used on 385 adults with mild to moderate headaches. A 0-10 Numeric Rating Scale was used to measure the severity of headaches prior to and an hour after the administration of paracetamol. Socio-demographic, health, and lifestyle factors were also measured. Descriptive statistics and paired sample t-test were used to analyze data.

Results: At pre-intervention, 26.9% of study participants had moderately severe pain (score 6), 24.4% severe pain (score 7), and 14.8% moderate pain (score 5). After intervention, 8.3% had no pain (score 0), 14.5% had very mild pain (score 1), and 20.2% had mild pain (score 2). Paired t-test revealed that there was a significant decrease in the severity of pain (mean difference = 2.987, SD = 0.631, 95% CI: 2.924-3.050, $t = 92.871$, $p < 0.001$).

Conclusion: The severity of the headache can be effectively reduced through timely analgesic intervention, resulting in rapid and measurable improvement in pain intensity in adult populations.

Keywords: Headache, Migraine, Analgesics, Pain Measurement, Paracetamol.

Introduction

Headache is a very prevalent neurological complaint throughout the world and also one of the most vital social health issues in the world (Cocores & Monteith, 2022). Headache has various types; tension headaches, which are mild to moderate in severity, or migraines, which may be severe, debilitating, and accompanied by other symptoms like nausea, photophobia, and phonophobia (Pan et al., 2025). Headache disorders in the population are associated with adverse effects on daily functioning, productivity at the workplace, and general quality of life (Tekin & Edem, 2022). Episodic migraine (EM) with or without aura is a diagnosis that can reflect occasional or frequent (<8) migraine days per month. It likely makes up the bulk of headache sufferers who regularly present to their doctor with a complaint of head discomfort that disrupts activity (Buse et al., 2021).

The high rates of headache show variability worldwide. Epidemiological surveys in Australia reveal that a significant percentage of adults complain of frequent headaches, with tension-type headaches and chronic migraine (CM) being the most common, as reported. CM likely affects approximately 3% of the Australian population and is estimated to affect 7.6% of Australian migraine sufferers (Eller & Cheng, 2022). Episodic migraine (EM) with or without aura is a diagnosis that can reflect occasional or frequent (<8) migraine days per month. It likely makes up the bulk of headache sufferers who regularly present to their doctor with a complaint of head discomfort that disrupts activity (Buse et al., 2021). Considering the effect of headache on the day-to-day functioning, numerous people tend to achieve immediate relief with the help of pharmacological interventions. One of the most used forms of medicine in the treatment of acute headache is analgesics, medications created to relieve pain (Naghdi et al., 2023). Analgesic agents include compounds

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such as nonsteroidal anti-inflammatory agents (NSAIDs) that provide ibuprofen, naproxen, acetaminophen (paracetamol), and combination products that may contain caffeine or other adjuvants (Sobhani et al., 2023).

The analgesic mode of action varies based on the analgesic. The action of NSAIDs is mainly by blocking the activity of enzymes known as cyclooxygenase (COX) (Khan et al., 2022). COX promotes the production of prostaglandins- lipid compounds that cause inflammation and sensitisation of pain receptors. NSAIDs suppress the production of prostaglandins and thereby decrease the level of inflammatory signaling and the nociceptive activation threshold(Jin et al., 2023). The mechanism of action of acetaminophen is not well established but has been hypothesized to be mediated through central modulation of pain pathways, perhaps by inhibition of COX in the central nervous system or by stimulation of descending inhibitory serotonergic pathways (Irinmwinuwa et al., 2022). The combination of these actions leads to the attenuation of pain signals and a subjective decrease in the severity of pain. The analgesics are very popular, and most of the agents can be obtained without a prescription. This is coupled with their relative safety at recommended doses, which has led to their ubiquitous application in the management of headaches (Wirth et al., 2024).

In Australia and other countries, individuals tend to self-medicate when the symptoms of a headache appear. They usually choose analgesics due to previous experience, pharmacist recommendations, or some general health-related data (Mishriky, 2024). The headache management clinical guidelines have also suggested personalized approaches to treatment. Simple analgesics may frequently be used as initial treatment of mild to moderate headache, with intensification to triptan, combination therapy, or prophylaxis for more severe or chronic illnesses like migraine (Rattanawong et al., 2024; Sacco et al., 2022). The determinants of analgesic action are not confined to pharmacological aspects. Psychological conditions, quality of sleep, level of stress, and experience with previous medications can alter pain perception and treatment response. Individual differences in therapeutic results may also be the result of biological factors, including the variability in the metabolism of the drug (Dagnino & Campos, 2022). Even though most of the literature now focuses on the analgesic efficacy of controlled clinical trials, there is little evidence on how a single dose of analgesic can result in headache severity in real-life applications within communities. Published studies are commonly focused on a particular type of headache, and results are not known in general or mixed populations of headache. Also, Australian cohort data are scarce, and there is little research on the impact of demographic, behavioral, and contextual variables on analgesic responsiveness in clinical practice.

This quasi-experimental study aimed to explore the role of one dose of analgesics on the severity of headache in adults in Australia. This study expects to produce evidence about the temporal efficacy of the routine use of analgesics by evaluating the change in the intensity of pain before and after analgesic treatment.

Methodology

Study Design and Population

The present study was a quasi-experimental study with a pre- and post-intervention design to assess the impact of one dose of analgesic on the severity of headache. The study was carried out on adult participants who had mild to moderate headaches during the period of recruitment. The appropriate sample size of 385 participants was taken into consideration, and it was thought to be sufficient to find the statistically significant difference in the severity of headaches before and after the administration of analgesics. A convenience sampling method was used to recruit participants in community and outpatient settings in Australia. The same intervention was provided to all of the participants, and the severity of headaches was assessed prior to and following the administration of the analgesic.

Ethical Considerations

Data collection was preceded by the relevant institutional ethics committee giving ethical approval to the study. The research was carried out as per the guidelines contained in the Declaration of Helsinki. The aim of the study, the procedures to be followed, the benefits that would be gained, as well as the possible risks were explained to all the participants. Each participant was enrolled with written informed consent. The involvement was voluntary, and the participants were guaranteed confidentiality and anonymity. They were told of their right to leave the study at any time without any repercussions.

Eligibility Criteria

The study followed the following eligibility criteria

Inclusion Criteria

1. Adults aged 18 years and above.
2. Patients who complain of mild to moderate headaches during examination.
3. Participants who had not used any analgesic drug to treat headache in the last 12 hours.
4. Those who could comprehend and give informed consent and make correct reporting of the severity of the headaches using a numeric pain scale.

Exclusion Criteria

1. Patients suffering from headaches who need urgent medical care.
2. Participants who had a documented history of having chronic headache disorders, who had regular preventive measures.
3. Patients who are known to be allergic or contraindicated to paracetamol.
4. Pregnant or nursing women should consider the possible considerations related to medications.

Intervention

The analgesic in the present study was paracetamol (acetaminophen), which is available as a single oral dosage of 500 mg. Paracetamol was chosen because it is highly used, has a good safety profile, and is recommended as the first choice of agents in mild to moderate headache. The same standard dose was given to all the participants to make them consistent, so that there is minimal variation in response based on the dosage difference.

Data Collection

The data collection was done through the use of a structured questionnaire. The age and gender of the participants were noted as baseline demographic data. The Numeric Rating Scale (NRS) was used to determine the level of severity of headache, with 0 resulting in zero pain and 10 representing the worst possible pain. The data collection was done in a standardized order. The first one was to have the participants rate their level of headache severity before the intervention (pre-intervention measurement). Subsequently, paracetamol 500 mg was orally administered in one dose. The participants they observed were then subjected to a specific time span of 60 minutes, which was the estimated time of analgesic effect. At this point, the participants were requested to re-evaluate and report the severity of their headaches on the same NRS (post-intervention measure). This pre-post evaluation enabled direct comparison of the severity of headache before and after drug administration of analgesics.

Outcome Measures

Headache severity was the outcome measure of primary interest and was considered as a continuous numerical variable on the 0-10 NRS. The primary measure of treatment efficacy was the change in severity of headache occurring after the administration of the analgesics. The independent variable was the administration of a single dose of analgesic, which was operationalized by the comparison between before and after the intervention as part of the paired study design.

Statistical Analysis

Statistical Package of the Social Sciences (SPSS) software was used to enter and analyze the data. Participant characteristics and scores of headache severity were summarized using descriptive statistics. Categorical variables were made up of frequencies and percentages, whereas continuous variables were made up of means and standard deviations. In order to assess the impact of the analgesic intervention on the severity of headache, a paired sample t-test was used to compare mean headache severity scores prior to and after the administration of the analgesics. This test was selected because it is suitable in terms of comparison between two related measurements concerning the same measures.

Results

The sample size was 385 participants, most of whom were young adults between 26 and 35 years (33.2%), and the next largest group was between 36 and 45 years (24.9%). The females were slightly higher (51.8%). The majority of the participants were well educated, 38.6% of them had a graduate degree, and 19.7% were postgraduate. The most significant proportion was among urban inhabitants (70.2%). The importance of such distributions lies in the possibility that age, gender, and education affect perceptions of headaches and reporting. The comparatively high percentage of young, well-educated urban adults can also indicate population groups that are more likely to engage in community-based research, as shown in Table 1.

Table 2 indicates that 55.4% of the participants were free of any chronic conditions, and the most significant comorbidities were migraine (18.7%) and hypertension (15.0%). The majority of participants (71.5

Table 1. Socio-demographic characteristics

Variable	Category	Frequency (n)	Percent (%)
Age (years)	18–25	82	21.2
	26–35	128	33.2
	36–45	96	24.9
	46–55	54	14.0
	≥55	25	6.5
Gender	Male	185	47.9
	Female	200	51.8
Education level	Primary	42	10.9
	Secondary	118	30.6
	Graduate	149	38.6
	Postgraduate	76	19.7
Residence	1 = Urban	271	70.2
	2 = Rural	114	29.5
	Total	385	99.7

Table 2. Health-related characteristics

Variable	Category	Frequency (n)	Percent (%)
Chronic conditions	None	214	55.4
	Hypertension	58	15.0
	Diabetes	41	10.6
	Migraine	72	18.7
Smoking status	Non-smoker	276	71.5
	Smoker	109	28.2
Alcohol use	No	163	42.2
	Yes	222	57.5

percent) did not smoke, and 57.5 percent used alcohol. The most significant fact is that migraine is an observed chronic condition with the potential to influence the severity of headache beforehand. High proportions of non-smokers and high prevalence of alcohol consumption give the context in which the perception of pain and its possible interaction with analgesic response should be interpreted.

Table 3 shows that in terms of lifestyle, almost half of the respondents had normal BMI (48.2%), with 31.3% being overweight and 14.8% obese. The majority of the participants did not take other medications (61.7%), which reduced the possibilities of confounding effects. The majority of physical activity was low-moderate (82.6% combined), and the proportion of previous analgesic users was high (35.8% regular and 48.4% occasional). These are significant findings, as baseline headache intensity and intervention effectiveness can be affected by pre-existing analgesic exposure and lifestyle characteristics such as BMI and activity level.

The most common types of headache were migraine (43.5) and tension-type (38.1), and the majority of the episodes lasted less than 24 hours (55.4) and were occasional (38.1). Commonly reported were stress (65.3%), sleep deprivation (56.7%), and environmental triggers, including light or noise (44.0%). The proportion of psychological factors was primarily medium and high (74.9%), and 70.7% of the respondents had a poor or moderate quality of sleep. These findings point to the

Table 3. Lifestyle and clinical characteristics

Variable	Category	Frequency (n)	Percent (%)
Body Mass Index (BMI)	Underweight (<18.5)	21	5.4
	Regular (18.5–24.9)	186	48.2
	Overweight (25–29.9)	121	31.3
	Obese (≥30)	57	14.8
Medication history (other ongoing medications)	Yes	147	38.1
	No	238	61.7
Physical activity level	Low	156	40.4
	Moderate	163	42.2
	High	66	17.1
History of analgesic use	Regular	138	35.8
	Occasional	187	48.4
	Never	60	15.5

multifactorial causes of headache intensity, with stress and sleep deprivation being especially dominant, and they could affect both baseline pain and analgesic responsiveness, as shown in Table 4.

Table 5 illustrates moderate to moderately severe pain among participants before the application of the analgesics, with the score 5-6 being used in 41.7 percent of the cases, and severe pain reported in 24.4 percent (score 7). The combination was very severe or extremely severe pain in 14.9%. Very mild or mild pain was only experienced by a small percentage (7.3). These baseline values demonstrate a significant headache burden to be used as a clear reference point when assessing the analgesic efficacy. The fact that the concentration of participants in moderate to severe categories is statistically meaningful to measure post-intervention change is significant.

After administration of 500 mg of paracetamol, the distribution of pain moved towards lower scores. It is important to note that 8.3% did not complain of any pain, and 14.5% complained of very mild pain. Severe and very severe pain scores dropped significantly to 2.3% and 0.8, respectively. Partially but significantly reduced pain was still associated with mild and moderate pain, which were the most prevalent categories. The post-intervention distribution indicates that there is a significant switch in moderate/severe to mild/no pain, which reflects the statistically significant effect of the single dose, as shown in Table 6.

The t-test on pre- and post-intervention pain scores showed that there was a significant decrease in the average severity of the headaches (mean difference = 2.987, SD = 0.631, 95% CI: 2.924-3.050, t = 92.871, df = 384, p = 0.001). This statistically significant improvement is a response that headache severity was significantly reduced, and the magnitude of that effect can be observed by the mean change. The findings are strong, as they show a steady progression in the whole cohort and confirm the impact of paracetamol in the real world, as shown in Table 7.

Discussion

One of the most common neurological complaints across the globe is headache, which impacts daily functional performance, productivity, and life quality (Wells-Gatnik & Martelletti, 2025). Primary headache disorders such as tension-type headache and migraine differ in intensity, including mild to severe, and are usually occasioned by stress, sleep deprivation, environmental and lifestyle habits (Hernandez et al., 2024). Acute headache is likely to be treated with analgesics, especially paracetamol, because it is safe, readily available, and effective(Mohammadian et al., 2025).

The participants in the study indicated that their baseline pain levels were primarily moderate and moderately severe, with the highest percentages of 6 (26.9) and 7 (24.4). This intense pain burden is compatible with the findings of another study in which moderate to severe levels of headache intensity are frequent in migraine and

Table 4. Headache characteristics, triggers, lifestyle, and related factors

Variable	Category	Frequency (n)	Percent (%)
Type of headache	Migraine	168	43.5
	Tension-type	147	38.1
	Cluster	32	8.3
	Other	38	9.8
Duration of current headache episode	<24 hours	214	55.4
	1–3 days	121	31.3
	≥3 days	50	13.0
Frequency of headaches	Rare (<1/month)	64	16.6
	Occasional (1–4/month)	147	38.1
	Frequent (5–10/month)	109	28.2
	Persistent (>10/month)	65	16.8
Stress	Yes	252	65.3
	No	133	34.5
Sleep deprivation	Yes	219	56.7
	No	166	43.0
	Total	385	99.7
Specific food trigger	Yes	98	25.4
	No	287	74.4
Weather / environmental changes	Yes	141	36.5
	No	244	63.2
Other triggers (light, noise, etc.)	Yes	170	44.0
	No	215	55.7
Psychological factors (stress level)	Low	96	24.9
	Medium	181	46.9
	High	108	28.0
Sleep quality	Good	112	29.0
	Moderate	176	45.6
	Poor	97	25.1
High caffeine intake	Yes	173	44.8
	No	212	54.9
	Total	385	99.7
Low caffeine intake	Yes	112	29.0
	No	273	70.7
Adequate hydration	Yes	204	52.8
	No	181	46.9
Poor hydration	Yes	148	38.3
	No	237	61.4

Table 5. Pre-intervention pain severity assessment

Pain Score	Description	Frequency (n)	Percent (%)
1	Very mild pain	4	1.0
2	Mild pain	10	2.6
3	Mild–moderate pain	18	4.7
4	Moderate pain	36	9.3
5	Moderate pain (significant)	57	14.8
6	Moderately severe pain	104	26.9
7	Severe pain	94	24.4
8	Very severe pain	46	11.9
9	Extremely severe pain	12	3.1
10	Worst imaginable pain	4	1.0

Table 6. Post-intervention pain severity assessment

Pain Score	Description	Frequency (n)	Percent (%)
0	No pain	32	8.3
1	Very mild pain	56	14.5
2	Mild pain	78	20.2
3	Mild–moderate pain	72	18.7
4	Moderate pain	61	15.8
5	Moderate pain (significant)	48	12.4
6	Moderately severe pain	26	6.7
7	Severe pain	9	2.3
8	Very severe pain	3	0.8

Table 7. Paired Sample Test

Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	pre-intervention assessment - post-intervention pain assessment	2.9870	.6311	.0322	2.9238	3.0503	92.871	384	.000

tension-type victims in community-based settings (Magne et al., 2025). Acetaminophen effected substantial changes in the intensity of pain in comparison to placebo, in acute migraine, from exceptionally moderate to severe pain. Mild reduction has been observed, or pain disappeared in two hours, supporting the post-intervention results (Shakeel et al., 2025). The prevalence of the types of headache in the cohort, 43.5% migraine, 38.1% tension-type, is a reflection of the internationally published literature, as these two main types of headaches are the most common (Río et al., 2025). The post-intervention levels of pain were significantly lower, with 8.3% reporting no pain and the majority reporting mild to mild-moderate pain (2-3 score). This decrease is in line with prior controlled evidence that paracetamol is better than placebo in the management of migraine (Gartlehner et al., 2025).

Another study reported that two 1000mg doses produce a low percentage of people pain-free or mild pain at 2 hours over placebo, an estimated number needed to treat of approximately 10 people is required to achieve positive results (Tepper et al., 2025). The present findings on the triggers of headaches are consistent with the general literature. Triggers often cited were stress (65.3%), sleep deprivation (56.7%), and, in line with the existing studies. Triggers most commonly supported in both migraine and tension-type headache groups were stress and sleep disturbances (Shaikh et al., 2025). The high rate of endorsement in our cohort supports the role of the psychosocial and lifestyle factors in the context of headache initiation and severity. Furthermore, studies show the bi-directional correlation between headache severity and poor sleep, with disturbed sleep being associated with increased frequency and intensity of headaches. The moderate to poor sleep quality and significant levels of stress in our sample of participants are thus consistent with known correlations between these triggers and the burden of headache (Almansour et al., 2025).

Strengths and Limitations of the Study

The strengths of this study are a quasi-experimental design with pre- and post-intervention measurement, a large sample size (n=385), and real-world community-based data, improving the external validity. The objective measurement of the severity of headaches was made possible by the use of a standardized Numeric Rating Scale. There are some limitations, such as the convenience sampling, that could restrict the generalization and the use of self-reported data on pain and lifestyle factors, which could introduce a reporting bias. The research also compared only one dose of paracetamol and no long-term follow-up.

Conclusion

The study concludes that one dose of 500 mg paracetamol has significant effects in lowering the severity of headaches among adults in the Australian community context, with a substantial decrease in pain from moderate-severe to mild or no pain in one hour. The most frequent headaches were migraine and tension-type headaches, with stress and sleep deprivation being the most widespread causes. These results confirm the usefulness of paracetamol in the real-life setting and emphasize the strength of demographic, lifestyle, and psychosocial variables in headache management. Overall, the results provide evidence-based insight into immediate analgesic response and the multifactorial nature of headache experiences in the general population.

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