Title: Association of complaints of the musculoskeletal disorders in arm, neck and shoulders with hand grip strength and load carried on the head in building construction workers in Calabar, Nigeria-A Cross-Sectional Study

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Abstract

Background: Information regarding how neck load and hand grip strength (HGS) influences the report of complaints of arm, neck and shoulder CANS among building construction workers is sparse. Objective: This study assessed the association of complaints of the musculoskeletal disorders in arm, neck and shoulders (CANS), hand grip strength (HGS) and load carrying capacity of the neck in building construction workers.

Methods: A cross-sectional design involving 174 consenting building construction workers in 15 construction sites of a metropolitan city. Participants were recruited using consecutive sampling. Participants' ages were obtained while weight, height, neck strength, HGS, and load carried on the neck were measured with standard instruments. Neck flexor strength was measured using easy force dynamometer. The Maastricht Upper Extremity Questionnaire was used to evaluate CANS. Data were summarized using frequency and percentages. Pearson's correlation coefficient was used to determine the relationship between participants' neck strength and each of age, height, weight, BMI, HGS and neck load. Also, Pearson's correlation coefficient was used to determine the relationship between participants' HGS and each of age, height, weight, BMI, and neck load. Chi-square test was used to determine the association between participants overall neck load and CANS, as well as between HGS and CANS. Level of significance was set at $p < 0.05$.

Results: The findings revealed a high prevalence of neck complaints (93.1%) and musculoskeletal pain (98.1%) in other parts of the body. Participants overall load carrying capabilities was significantly associated with the presence of musculoskeletal pain (χ^2=134.66, p=0.027), while HGS was significantly associated with shoulder complaint (χ^2=401.78, p=0.032). A significant negative weak relationship was found

between age and neck load (r=-0.17, p=0.030), while a significant positive weak relationship was found between neck flexor muscle strength and load carried on their head and neck 0.18, p=0.020).

Conclusion: Neck pain and complaints are highly prevalent in building construction workers who carry loads on their neck. The load carried by building construction workers is associated with their experience of musculoskeletal pain. Also, HGS is associated with shoulder complaints in building construction workers.

Keywords: Complaints of Arm, Neck and Shoulders; Hand Grip Strength; Neck Load; Building Construction Workers.

Introduction

Complaints of the arm, neck, and/or shoulders (CANS) refer to musculoskeletal issues characterized by pain, stiffness, diminished strength, tingling from the neck to the hand (Tella et al, 2021). Complaints of the arm, neck, and/or shoulders manifest at workplace, home or during recreational activities, earning colloquial names like mouse arm, tablet neck, smartphone wrist, Gameboy thumb, or WhatsApp thumb (Berolo et al, 2011). Alarming statistics in Western countries revealed that the working population experiences physical complaints associated with CANS to varying degrees (Brunnekreef et al, 2022). These complaints exhibit a gradual and insidious onset, worsening if the root cause is unaddressed.

Broadly, CANS are categorized into specific and non-specific. Specific categories include well-defined conditions like tennis elbow, golfer's elbow, thoracic outlet syndrome, or tendonitis, while non-specific complaints arise when a definitive diagnosis is elusive (Koh, 2021). The prevalence of CANS in physically demanding jobs is reported to be high with a lifetime estimate of 6 and 67% in the general populations (Hodgetts et al, 2021). The point prevalence is reported to range from 1.6% to 53% with a12-month prevalence of 2.3% to 41% (Hutting et al, 2015). Tella et al. (2021) reported a 70% one-year prevalence of CANS among computer users in Lagos, Nigeria. It affects the quality of life and physical health of workers in physically demanding jobs, thus reducing workers productivity (Hodgetts et al, 2021).

Specific physical factors contributing to CANS involve intense, rapid, and awkward movements of body parts, such as bending, straightening, gripping, holding, twisting, clenching, and outstretching of hands and arms (Koh, 2021). Additionally, extreme body postures, inadequate recovery time, and exposure to vibrations contribute to these disorders (Charles et al, 2017). Psychosocial factors of CANS comprise working in monotonous work or having no autonomy at work, limited social interaction, isolated work environments, pressure to achieve high performance, and having time constraints among others (Tella et al, 2021). Musculoskeletal disorders (MSDs) pose a significant health challenge to construction workers and the general population. Complaints of arm, neck and shoulders is a derivative of work-related musculoskeletal disorders (WMSDs) when primarily induced or exacerbated by job-related activities or the immediate work environment (Barthelme et al, 2021).

The aetiology and pathogenesis of WMSDs leading to CANS are intricate and multifaceted involving a myriad of risk factors that interact in complex combinations (Turci et al, 2021). A longitudinal study found strong evidence for an association between shoulder complaints and manual material handling, vibration, trunk flexion or rotation and working with hands above shoulder level (Mayer et al, 2012). However, there exist limited understandings regarding modifiable and biomechanical risk factors including combinations of exposure to upper arm elevation, high repetition, static shoulder postures, forceful exertion, and hand-arm vibration for CANS (Meyers et al, 2023). Musculoskeletal disorders in upper extremities were found to be associated with physical demands involving repetitiveness and force (Fonseca and Fernandes, 2010). Meyer et al, (2023) stated that biomechanical exposures as risk factors for shoulder MSDs are not well characterized hence highlighted the importance of assessing combinations of exposure to forceful repetition and upper arm elevation when developing interventions for preventing shoulder complaints. More so, there are indications that strength training programme focused on alleviating CANS would be helpful for affected individuals (da Silva et al, 2022).

A strong correlation was reported between hand grip strength (HGS) and shoulder strength of healthy volunteers (Horsley et al, 2016). However, Lopes et al, (2024) found that HGS and shoulder abduction strength were inversely associated with upper extremity dysfunction. Thus, HGS is viewed as a viable assessment tool for upper extremity activities of daily living (Wollesen et al, 2020). The literature is replete with studies of HGS and CANS but its impacts on musculoskeletal disorders associated with load carrying on the head among builders have not been widely reported.

Hand grip strength was reported to influence shoulder and wrist pain of individuals and industrial workers (AlAnazi et al, 2022; Wollesen et al, 2020). Also, HGS was reported to influence neck pain and risks of MSDs (Fayez, 2014). It is believed that variable factors of altered biomechanics, faulty posture and spinal loading are linked with neck pain intensity and neck movement (Fayez, 2014). Building construction workers, especially brick layers are often involved in activities of bending, twisting, lifting, repetitive movements of the upper extremity and carriage of light and heavy objects in the hand or on the head (Adedoyin et al, 2022). Also, building construction workers frequently bear heavy loads on their heads, necks, and hands which may make

them susceptible to CANS (Jeong and Lee, 2024). Loading of the cervical spine has been reported as a risk factor for neck pain in populations that use their heads to carry loads (Rafique et al, 2021). The practice of neck loading may impose excessive stress on the cervical spine, shoulders, and upper limbs, elevating the likelihood of MSDs and CANS in upper extremity. Complaints of arms, neck and shoulder can adversely affect workers' health, productivity, and quality of life (Boschman et al, 2012). The literature regarding how neck load and HGS influences the report of CANS among building construction workers is sparse (Jeong and Lee, 2024). Hence, this study investigated the association of CANS with HGS and load carrying capacity of the neck in building construction workers.

Methods

This is a cross-sectional study that utilized consecutive sampling to recruits participants. The construction sites were conveniently selected. The participants were male building construction workers who used head pans to carry load (concrete) in building construction sites. Inclusion criteria were participants aged 18-60 years with ability to read and understand English and working in a building construction site consistently for not less than 6 months. Participants were excluded if they had previous history of trauma like fracture or dislocation, systemic diseases like rheumatoid disease, malignancies, prostheses, amputation, or congenital defects.

The Yamane (1967) formula $n = N / 1+N(e^2)$ was used to determine the sample size of the study. In using this formula, N=Population size=306 (Obtained from the builders' association of Calabar Metropolis and e=level of precision or sampling error, which was is 5% = 0.05. Hence, $n = 306 / 1+306(0.05^2) =174$. Thus, 174 construction workers were recruited to participate in this study. Ethical approval was obtained from Ethics and Research Health Committee of a University of Teaching Hospital. Signed informed consent was obtained each participant before data collection.

Data was collected in the following order. Participants' age was obtained and recorded. Anthropometric parameters of height and weights were measured with the participants wearing light apparel with no shoes. Weight was measured using a portable weighing scale (Hana bathroom mechanical scale) to the nearest 0.1Kg. Height was measured

with a height meter to the nearest 0.1m. Body mass index (BMI) was computed by calculating the ratio of weight in kilogram to height in metre squared.

Assessment of neck strength: The participants' neck extensors muscle strength was measured using easy force dynamometer (Meloq). Each participant was asked to lie in supine lying (for measurement of neck flexors strength) and prone lying (for measurement of neck extensors strength) on a couch, while the dynamometer was anchored around the head as described by Martins et al. (2022). The maximum load reading from the dynamometer was recorded in Kilogram (Kg). The obtained values were converted to force in Newton (N) by multiplying it with the value of the acceleration due to gravity ($9.81 m/s^2$).

Assessment of hand grip strength: Hand grip strength was measured in kilogram (Kg) using CAMRY digital hand dynamometer according to the protocol of the American Society of Hand Therapists (Fess and Moran, 1981). Participants were asked to stand in an upright position with the shoulder adducted and neutrally rotated, the elbow at 90° flexion, and the forearm and wrist in a neutral position (Fess and Moran, 1981). Participants were instructed to squeeze the digital hand grip dynamometer handle maximal effort and sustain the grip for 3 to 5 seconds. Each participant performed three trials per hand, and the highest value recorded. The maximum grip strength for the dominant hand was assessed and recorded.

Weight of the Headpans: The weight of headpan and its content were measured with and without load, using (Hana bathroom weighing scale) to the nearest 0.1Kg.

Assessment of complaints of arms, neck and shoulders: Maastricht upper extremity questionnaire (MUEQ) was used to measure the risk factors for work-related musculoskeletal disorders. The questionnaire consists of 95 questions that can be completed in approximately 20 minutes. Other than demographic questions, the questionnaire has seven main sections: Workstation; Body posture; Job control; Job demands; Quality of rest breaks; Work environment, and Social support. A complementary part of the questionnaire was designed to determine the frequency and the nature of pain in the neck and upper extremity (Eltayeb et al, 2008). All items either has a five-point scale (always-never) or a dichotomous statement (yes-no). The MUEG has Cronbach's scores of 0.52 to 0.84, and ICC scores greater than 0.70 (Junior et al,

2023). The MUEQ was distributed to the participants to be self-completed and returned on the same day.

Data analysis: The data was analyzed using statistical package for the social sciences (SPSS Version 26.0). Participants' parameters of age, height, weight, BMI, HGS, neck flexor and extensor strengths, neck load, and weight of head pan were summarized with descriptive statistics of mean and standard deviation, while CANS were summarized frequency and percentage. Pearson's correlation coefficient was used to determine the relationship between participants' neck strength (flexor and extensor) and each of age, height, weight, BMI, HGS and neck load. Also, Pearson's correlation coefficient was used to determine the relationship between participants' HGS and each of age, height, weight, BMI, and neck load. Chi-square test was used to determine the association between participants overall neck load and CANS, as well as between HGS and CANS. Level of significance was set at $p<0.05$.

Results

Table 1 presents the demographic and physical characteristics of all participants. The participants had a mean age of 34.47±5.63 years, height of 1.75±0.06m and a normal BMI of 24.58±1.39Kg/m2. The average HGS was 52.26±3.92Kg, while the mean neck extensors muscle strength was higher than the mean neck flexors muscle strength (172.62 ± 37.47N vs 115.95 ± 40.22N). The mean overall load carried by participants' neck was 29.16±4.91Kg.

The prevalence of CANS by body part was highest in the neck (93.1%), followed by both upper arms (40.2%), both elbows (33.9%) and lowest in the wrists (3.4%), the right and left shoulders (3.4% vs 1.7%), respectively (Table 2). The one-year prevalence of pain in the past year in the upper musculoskeletal extremity was 98.3%. In the past one year, 65.3% of participants reported 1 to 7 days as the longest period when they could not perform daily activity (Table 3). More than one third (36.8%) of the participants reported medications usage as the treatment they had received in the past 1 year, while very few, 5.7% and 2.3% had physician and physiotherapy treatments, respectively (Table 3). The work activity of most (78.7%) of the participants were hindered in their work due to upper extremity musculoskeletal complaints in the past 1

year (Table 3). About half (47.7%) of the participants reported that their leisure activities were hindered due to upper extremity musculoskeletal complaints (Table 3).

On the presenting symptoms of CANS, about half (47.7%) of the participants reported that the pain they experienced as soon as they finished work persisted after a short rest (Table 4). A total of 40.8% reported that the fatigue and exhaustion they felt after work persists after a short rest (Table 4). Majority of the participants felt stiffness in the upper extremity and more than half (52.9%) felt continuous pain in the upper extremity (Table 4). Also, 50.0% of the participants reported change in the skin color or temperature (Table 4).

A statistically significant negative weak relationship (r=-0.17, p=0.030) was found between participants' age and overall load carried bear on their head (Table 5). A statistically significant positive weak relationship (r= 0.15, p=0.048) was found between participants' BMI and HGS (Table 5). Also, a statistically significant positive weak relationship (r= 0.18, p=0.020) was found between participants' neck flexors' muscle strength and overall load they carried on their head (Table 5). There was no statistically significant relationship (p>0.05) between participants' extensors' muscle strength and overall load they carried on their head (Table 5). The weight of the load participants carried on their head was significantly associated with the experience of musculoskeletal pain (χ^2=134.66, p=0.027), while HGS was significantly associated (χ^2=401.78, p=0.032) with shoulder complaint (Table 6).

Discussion

This study evaluated the association of CANS with HGS and load carried on the head among building construction workers in a metropolitan city. The mean age of the participants in this study revealed a predominance of young adults with normal BMI. This finding is consistent with the report of age range of 25 to 34 making up the largest labour force in Nigeria (Sasu, 2020). It is believed that youth within the ages of 18 to 35 years constitute a substantial number of artisans on construction sites (Abdullahi et al, 2015). This demonstrates the interest of young adults in building construction sites in order to earn a living. The findings of normal BMI and substantial HGS suggest that these workers might have an adequate baseline level of physical fitness and lifting capacity, which is crucial for performing demanding tasks in construction works

(Mohapatra et al, 2022). Strong grip strength is positively correlated with overall physical health according to Musalek and Kirchengast (2017), reducing the risk of musculoskeletal disorders. Additionally, workers who can manage heavier loads with relative ease may experience fewer complaints related to their arms, neck, and shoulders, as they are likely better adapted to the physical demands of their jobs (Reddy et al, 2016).

The mean values of neck flexors and extensors strengths obtained in this study were higher than that reported in young adults of the same age group by a previous study (Kumar et al, 2001). This is, however, expected given that the participants in this study were building construction workers that carry loads on the heads, while those in the previous study were apparently healthy young adults. A possible reason could be the muscle strengthening through adaptation to impose demands when the loads are carried on the head by the construction workers.

The prevalence of musculoskeletal complaints in this study aligns with existing literature, which indicates that construction workers are particularly susceptible to neck and shoulder disorders due to the physical demands of their jobs (Reddy et al, 2016). The striking statistic that 93.1% of participants reported neck complaints underscores the significant impact of a loaded neck and repetitive motions typical in construction work. This is consistent with findings from a previous study that demonstrated a high incidence of neck pain of 60.2% among workers engaged in manual labor, suggesting an association between physical demands and the prevalence of musculoskeletal disorders (Cezar-Vaz et al, 2023). This is consistent with the findings of this study of significant association between overall neck load carried by the participants and their experience of neck pain.

This one-year prevalence of neck pain of respondents in this study was extremely high, indicating that upper extremity pain is predominant in building construction workers. Hence, this necessitates the need for building construction workers to routinely seek intervention from health care providers, especially physiotherapists given that the pain is due to physical demand, and in order to prevent chronic pain in the upper extremity. Health care providers should create awareness about the need for regular screening of neck in building construction workers. Also, physiotherapists should engage in

enlightenment programmes on the benefits of ergonomic advice and the use of physical modalities to treat or prevent neck pain in building construction workers.

Moreover, the reported complaints in the upper arms and elbows suggest that while neck pain may dominate, issues in other areas are not negligible. The prevalence of upper arm and elbow complaints can be attributed to repetitive lifting and the use of hand tools, which are common in construction settings (Lee et al, 2023). This reinforces the need for comprehensive ergonomic assessments and interventions to address not only neck pain but also discomfort in the arms and elbows.

In the past year, 98.3% participants reported experiencing pain, complaints in their upper musculoskeletal extremity. The near-universal reporting of upper extremity complaints among participants' highlights a concerning trend in the prevalence of musculoskeletal issues within this workforce. Such high figures are supported by existing literature, which consistently points to construction workers facing significant physical demands that often lead to chronic pain and functional limitations (Arias et al, 2022). This aligns with studies indicating that manual laborers frequently endure high rates of upper extremity injuries, necessitating the need for targeted interventions to improve worker health and safety (Arias et al, 2022). In contrast, the relatively low percentages of participants receiving professional treatment for their complaints, only 5.7% referred to a physician and 2.3% undergoing physiotherapy, while a third had self-medication suggests a potential underestimation of the severity of their conditions. Many workers might not seek help due to a lack of awareness regarding the importance of early intervention or fear of job loss associated with reporting injuries. Literature indicates that workers in physically demanding jobs may normalize their pain, viewing it as an expected part of their labor, which can lead to delayed treatment and exacerbated conditions (Andrasfay et al, 2023).

The finding of this study that about half of the participants felt their activities were hindered by upper extremity complaints reveals the substantial impact of these issues on daily life. This aligns with research that highlights how MSDs can lead to significant reductions in productivity and quality of life (Mansoor et al, 2022). The range of symptoms reported by the majority of participants including continuous pain, stiffness, and changes in skin color or temperature, paints a picture of the multifaceted nature of these complaints. The presence of stiffness and color changes may indicate not only

overuse injuries but also circulatory or neurological issues, which may require a more comprehensive approach to treatment and rehabilitation (Aicale et al, 2018). Existing literature supports the idea that early recognition and management of such symptoms can prevent long-term disability, further emphasizing the importance of proactive health measures (AbdulRaheem, 2023). Interestingly, all participants did not use ergonomic aids such as collars, belts, or supports, which highlight a negative step towards mitigating pain and discomfort. This finding is a reflection that very few respondents sought the intervention or advice of health care professional for their job. However, the implementation of such aids often depends on proper recommendation by health professionals for specific tasks being performed by building construction workers. While these aids may reduce strain, their mere presence does not guarantee they are being utilized correctly or adequately addressing the underlying issues causing pain. Therefore, ongoing education and ergonomic assessments are crucial in maximizing the benefits of these interventions.

The finding of the negative correlation between age and overall neck load implies that the older the construction workers, the less the load they carry on the neck. This aligns with existing literature that suggests muscle strength typically declines with age (Distefano and Goodpaster, 2017). This finding is particularly relevant in physically demanding occupations, where decreased strength can lead to increased susceptibility to injury. As construction workers age, they may experience diminished capacity to perform tasks that require significant neck stability and strength, potentially leading to higher rates of musculoskeletal complaints (Schwatka et al, 2011). Conversely, the negative relationship between weight and neck extension strength raises questions about the role of excess weight in physical performance. This supports the body of literature that emphasizes the importance of maintaining a healthy weight to optimize physical performance and reduce injury risk (Knapik, 2015).

The significant association between overall neck load and presence of musculoskeletal pain suggests that increased loads directly contribute to the physical strain experienced by workers, a finding that resonates with existing literature (Arias et al, 2022). A previous study asserted that heavy lifting and prolonged exposure to weight can lead to increased rates of musculoskeletal disorders, particularly in the neck and upper extremities (Kadota et al, 2020). This relationship is especially critical in construction

settings, where the physical demands are substantial, and the risk of injury escalates with the weight being handled. Additionally, the absence of significant associations for complaints in the shoulder and other regions of the upper extremity could indicate that participants might have adapted to tolerating loads over time in this regions. Workers in physically demanding jobs often develop coping mechanisms, which could mask the impact of heavy loads on specific areas of discomfort (Kent et al, 2018). Literature supports the idea that adaptation can lead to a higher tolerance for pain, complicating the relationship between load and reported symptoms (Sturgeon and Zautra, 2010).

The significant association between HGS and shoulder complaints highlights the importance of grip strength as an indicator of upper body function. Strong grip strength is often correlated with overall muscle health and stability, suggesting that individuals with weaker grip may be at higher risk for shoulder issues (Horsley et al, 2016). This finding is supported by literature that emphasizes that grip strength is a predictor of musculoskeletal health, particularly in populations engaged in manual labor (Vaishya et al, 2024). Shoulder pain, as in rotator cuff disorder, can be exacerbated by insufficient muscular support, making grip strength a valuable measure for assessing the risk of developing shoulder-related complaints (Horsley et al, 2016).

Overall, this study recommends regular health assessments as a standard practice for building construction workers. These assessments can serve as a critical early warning system, identifying potential issues before they escalate into more serious problems. By investing in routine health checks, employers and employees can show their commitment to workers well-being; ultimately saving costs associated with injury treatment and lost productivity. Finally, promoting awareness of pain management options will empower workers to take control of their health.

However, this study did not assess the psychological factors associated with CANS in building construction workers, and as such is a limitation of this study. Hence, further studies should examine the role of psychosocial factors, such as stress, job satisfaction, and workplace culture, in the prevalence of CANS among building construction workers. Understanding how these factors interact with physical demands and ergonomics could provide a more comprehensive picture of workers' health to health care professionals. Policies to encourage routine health check by building construction

workers or the provision of health care services by employers of labor may help mitigate the prevalence of CANS in the population.

Conclusion

Neck pain and complaints are highly prevalent in building construction workers who carry loads on their neck. The load carried by building construction workers is associated with their experience of musculoskeletal pain. Also, HGS is associated with the shoulder complaint in building construction workers.

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Table 1: Physical characteristics of all participants

Variables	Mean ± SD	Minimum	Maximum
Age (years)	34.47 ± 5.63	25.00	55.00
Height (m)	1.75 ± 0.06	1.57	1.86
Weight (Kg)	75.03 ± 6.82	62.00	98.00
BMI (Kg/m^2)	24.58 ± 1.39	20.48	31.98
Hand grip strength (Kg)	52.26 ± 3.92	43.00	68.70
Neck flexors strength (N)	115.95 ± 40.22	50.03	193.26
Neck extensors strength (N)	172.62 ± 37.47	96.14	249.17
Weight of head pan (Kg)	3.69 ± 0.76	2.50	5.00
Load (Kg)	25.46 ± 4.81	16.70	38.00
Overall neck load (pan + load) (Kg)	29.16 ± 4.91	21.40	41.20

Key: BMI= Body mass index; SD=Standard deviation

Table 2: Location of Musculoskeletal Complaints (N=174)

Musculoskeletal Complaints	Categories	Frequency (N)	Percentage (%)
Neck	No	12	6.9
	Yes	162	93.1
	No	153	87.9
Shoulders			
	Yes		
	Both	12	6.9
	Right	6	3.4
	Left	3	1.7
	No	63	36.2
Upper Arms			
	Yes		
	Both	70	40.2
	Right	19	10.9
	Left	22	12.6
	No	78	44.8
Elbows			
	Yes		
	Both	59	33.9
	Right	21	12.1
	Left	16	9.2
	No	119	68.4
Lower Arms			
	Yes		
	Both	14	8.0
	Right	21	12.1
	Left	20	11.6
	No	140	80.5
Wrists			
	Yes		
	Both	6	3.4
	Right	19	10.9
	Left	9	5.2
	No	88	50.6
Hands			
	Yes		
	Both	25	14.4
	Right	30	17.2
	Left	31	17.8

Table 3: One year prevalence of complaints of the arms, neck and shoulder in building construction workers (N=174)

Musculoskeletal Complaints of Arm, Neck and Shoulder	Categories	Frequency (N)	Percentage (%)
During the past year I had pain/complaint/disability in my upper musculoskeletal extremity	No	3	1.7
	Yes	171	98.3
The longest period of complaint (in the past year) whereby I could not perform my daily activity was	0 day	22	12.6
	1 day	10	5.7
	2 days	17	9.8
	3 days	11	6.3
	4 days	14	8.0
	5 days	38	21.8
	6 days	18	10.3
	7 days	6	3.4
	8 days	27	15.5
	9 days	7	4.0
	14 days	1	.6
	21 days	2	1.1
	35 days	1	.6
During the past year I was referred to the physician due to my upper extremity pain?	No	164	94.3
	Yes	10	5.7
What kind of treatment did you receive (during the past year)	None	105	60.3
	Medication	64	36.8
	Physiotherapy	4	2.3
	Surgery	1	0.6
Because of my upper extremity pain, I have lost a job before	No	167	96.0
	Yes	7	4.0
Because of my upper extremity complaints (during the past year) I was absent from work	No	158	90.8
	Yes	16	9.2
Due to upper extremity complaints in the past year my activities were hindered in my work	No	37	21.3
	Yes	137	78.7
Due to upper extremity complaints in the past year my activities were hindered in my leisure activity	No	91	52.3
	Yes	83	47.7
My complaints are due to a previous accident	No	158	90.8
	Yes	16	9.2

Table 4: Rate of symptoms of complaints of the arms, neck and shoulders in building construction workers (N=174)

Variables	Frequency (n)	Percentage (%)
Presenting Symptoms of CANS		
I feel pain as soon as I finish work		
Disappears after short rest	54	31.0
Persists after short rest	83	47.7
I feel fatigue&exhaustion after work		
Disappears after short rest	71	40.8
Persists after short rest	71	40.8
I feel stiffness in my fingers		
Disappears after short rest	45	25.9
Persists after short rest	32	18.4
I feel numbness in my fingers		
Disappears after short rest	96	55.2
Persists after short rest	21	12.1
I feel tingling in my fingers		
Disappears after short rest	26	14.9
Persists after short rest	37	21.3
I feel weakness in my upper extremity		
Disappears after short rest	108	62.1
Persists after short rest	36	20.7
I suffer from swelling in my hands		
Disappears after short rest	9	5.2
Persists after short rest	19	10.9
I feel stiffness in my upper extremity		
No	70	40.2
Yes	104	59.8
I feel continuous pain in upper extremity		
No	82	47.1
Yes	92	52.9
I feel a change in skincolour/temperature in my upper extremity		
No	87	50.0
Yes	87	50.0
I use collar/belt/supports to reduce pain		
No	174	100.0
Yes	0	0.0

Key: CANS=Complaints of the arm, neck and shoulder

Table 5: Relationship among hand grip strength, neck strengths and overall neck load with age and anthropometric parameters in building construction workers

Variables	HGS		Neck strengths				Overall neck load	
			Flexors		Extensors			
	r	p	r	p	r	p	r	p-value
Age (years)	0.09	0.262	-0.01	0.912	0.05	0.528	-0.17	0.030*
Weight (Kg)	0.15	0.052	-0.05	0.487	-0.16	0.034*	0.03	0.730
Height (m)	0.07	0.347	-0.01	0.880	-0.12	0.109	0.05	0.485
BMI (Kg/m^2)	0.15	0.048*	-0.08	0.311	-0.11	0.142	0.03	0.691
HGS (Kg)	1	0.000	-0.02	0.805	-0.13	0.089	-0.06	0.452
Neck strengths								
Flexor (N)	-0.02	0.805	1	0.000	0.44	0.000	0.18	0.020*
Extensor (N)	-0.13	0.089	0.44	0.000	1	0.000	0.02	0.773
Overall neck load	-0.06	0.452	0.18	0.020	0.02	0.773	1	0.000

Key: HGS= Hand grip strength; BMI=Body mass index; r= Pearson;s correlation coefficient; *=p is significant at < 0.05.

Table 6: Association of neck load and hand grip strength with complaints of the arms, neck and shoulder in building construction workers (N=174)

Variable	χ^2	p-value
Overall neck load VS CANS		
Load VS Neck compliant	107.81	0.406
Load VS Shoulder compliant	312.51	0.529
Load VS Upper arm compliant	300.91	0.707
Load VS Elbows compliant	300.42	0.713
Load VS Lower arm compliant	312.26	0.533
Load VS Wrists compliant	281.50	0.913
Load VS Hand compliant	292.97	0.808
Load VS MSK Pain	134.66	0.027***
HGS VS CANS		
HGS VS Neck compliant	132.47	0.156
HGS VS Shoulder compliant	401.78	0.032***
HGS VS Upper arm compliant	333.77	0.738
HGS VS Elbows compliant	358.56	0.379
HGS VS Lower arm compliant	380.40	0.135
HGS VS Wrists compliant	373.99	0.191
HGS VS Hand compliant	367.31	0.264
HGS VS MSK Pain	114.98	0.535

CANS=Complaints of the arm, neck and shoulder; HGS=Hand grip strength; ***=p is significantly different.