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**Comparison of the head and neck positions in ridden horses advertised in an Australian horse sales
magazine: 2005 versus 2018**

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Abstract

The impact of head and neck position (HNP) on horse welfare has received much attention in the scientific literature within the last two decades. Studies have identified physiological and behavioural signs of distress in horses ridden for prolonged time in a HNP with their noseline behind the vertical (BTV), which may compromise their welfare. The objective of this study was to compare potential differences of HNPs shown in horse sales photographs advertised in an Australian horse sales magazine (Horse Deals) from the years 2005 and 2018. Additionally, factors potentially impacting HNPs, such as type of tack presented in (e.g. noseband type), riding discipline, competition experience of the horse, were investigated. The sample population (n=570) comprised horses ridden with headgear and bit in walk, trot, or canter/gallop, advertised in an Australian horse sales magazine. Issues from April 2005 and October/November 2018 were selected. HNP was categorised as behind the vertical (BTV), on the vertical (OV), slightly in front of the vertical (IFV), or extremely in front of the vertical (EIFV) (any HNP >30° IFV). Data were analysed using Chi-squared test and post-hoc testing via a multiple regression approach through SPSS, and test of proportions via the z-score calculator for two independent population proportions. Analysis of combined data from years 2005 and 2018 showed 47.0% (n=570) of the horse sample population were advertised with HNPs BTV. BTV HNP was observed as the predominant HNP (57.8%) (n=268), in the warmblood/eventers/show/performance (WESP) category ($p < 0.0005$). In 2005, 53.4% (n=303) of the sample population were ridden BTV compared to 39.7% (n=267) in 2018 ($p < 0.001$), 12.9% (n=303) were OV in 2005 compared to 15.0% (n=267) in 2018 ($p > 0.05$), and 10.9% (n=303) were IFV in 2005 compared to 27.3% in 2018 (n=267) ($p < 0.0004$). These results suggest a positive development with less vendors/riders selecting images where the horse's nose was BTV. However, this may be explained by the larger proportion of horses advertised in the WESP category in 2005 (63.0%) (n=303) vs. 2018 (28.5%) (n=267), and the WESP category predominantly comprised of dressage, jumper, and eventing horses. In addition, the reduction of HNPs BTV from 53.4% (n=303) in

2005 to 39.7% (n=267) in 2018 could be attributed to the observation that in 2018, a larger proportion of horses were listed in categories that do not require the horses to be worked with a flexed HNP referred to as 'on-the-bit' (e.g. Western, Endurance, Australian Stock Horses). The HNP BTV remains preferential by a substantial proportion of the horse owning public when advertising horses for sale, particularly in disciplines where the horse is worked in a flexed HNP or 'on-the-bit'.

Keywords: Head and neck position; equitation science; equine welfare; horse training; dressage.

Conflicts of interest: None

1. Introduction

The dispute about which head and neck position (HNP) in horse training should be considered correct is an old one and can be traced back hundreds of years [1]. Indeed, overbending a horse's neck, also known as hyperflexion, has been advocated as a training method by some horse trainers since the 16th Century [2]. More recently, there has been growing focus on the social license to operate across equestrian sport, resulting in increased awareness and debate of how traditional riding practices influence equine welfare and well-being [3,4]. Recent high profile examples of extreme HNP and the use of Rollkur (also spelled Rollkür), defined as overbending or hyperflexion of the horse's head and neck [5], within training and competition have increased the debate of how horses' HNP influence their welfare. This combined with advances in technology, has seen the scientific community exploring the impact of different HNPs on factors such as equine biomechanics [6,7], muscle activity [8], and equine stress responses [9-11]. Whilst studies indicate BTV HNP is associated with compromised welfare in the horse [9-13], there is a lot of evidence of growing disapproval of the hyperflexion training method by a proportion of the equestrian community [14,15]. In 2010 the FEI redefined the terms hyperflexion, overbending and Rollkur, branding them under one term [16]: LDR (Low, Deep and Round). Concurrently, the FEI restricted the use of LDR to skillful riders during warm-up in competition [17]. In contrast to the definitions of hyperflexion and Rollkur, the FEI definition of LDR implies the absence of force when asking the horse to take and maintain the LDR HNP. Although the FEI fails to outline how rider skill levels and abuse of LDR can be reliably measured to ensure horse welfare [17], stewards are provided with broader guidance as to when to intercede in case riders fail to adhere to FEI guidelines [17].

A hyperflexed HNP describes a maximum arched neck with the horse's chin almost touching its chest (dorso-ventrally hyperflexed cervical spine) [6]. Horses can voluntarily assume a hyperflexed HNP at liberty, for instance when harem tending or expressing agonistic behaviour [18], however, this HNP is

maintained only for a few seconds at a time. Hyperflexion of the head and neck in ridden horses can represent a reaction to a painful stimulus caused by aggressive riding and harsh rein aids [19]. Strong rein contact can prompt horses to evade bit pressure and, ultimately, pain, through taking and maintaining a hyperflexed HNP [20]. In the worst case, this training approach can force the horse into a state of “learned helplessness” [21] where it has learned that it can only avoid pain by overbending its head and neck [22]. Consequently, some riders/trainers may disregard the basic principles of learning theory when hyperflexing their horses’ heads and necks [23] and, therefore, compromise equine welfare. Indeed, a meta-analysis on the effect of HNP on welfare and other physiological parameters such as kinematics [24] concluded that only one out of 55 scholarly articles focusing on HNP indicated positive effects of hyperflexion on horses. In equitation, the flexion of the poll and arching of the neck through taking contact with the horse mouth via bit and reins is the result of systematic training and conditioning of the horse. Flexion of the horse’s poll and neck in the discipline of dressage is seen as a continuous process [22], gradually achieved through the “Gymnastizierung” of the equine athlete following the German training scale [25,26] (Figure 1). At any training stage, BTV HNPs are not desired and described as a ‘fault’, for example, in riding manuals [25] and official dressage rulebooks [26].

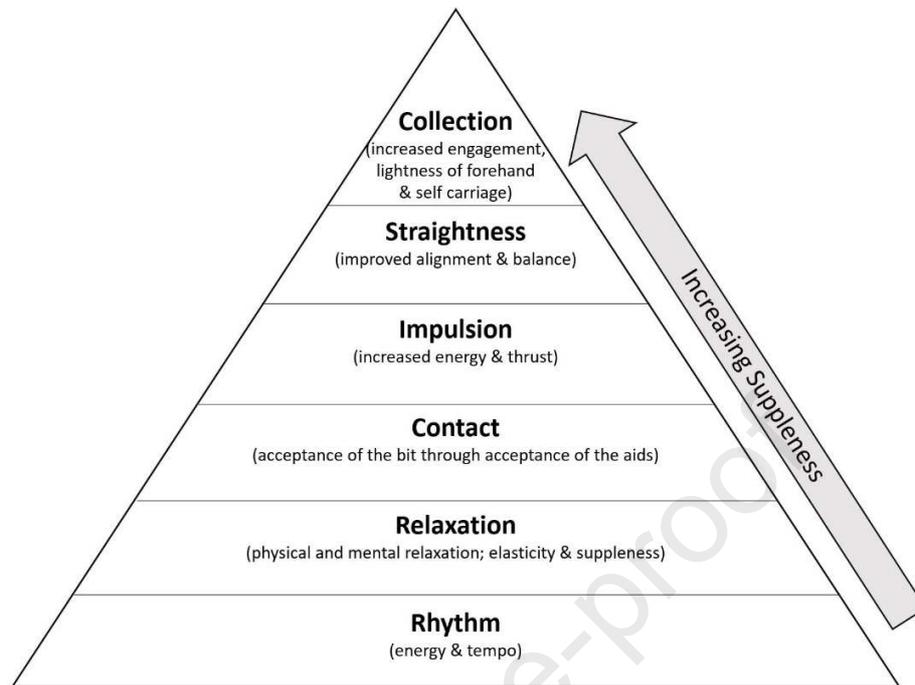


Figure 1: The German horse training scale

Indeed, the FEI dressage rulebook states the horse "(...) head should remain in a steady position, as a rule slightly in front of the vertical, with a supple poll as the highest point of the neck (...)" [26 p.9]. However, in contrast to this guidance, horses working with BTV HNP are frequently observed across a range of equestrian disciplines, particularly where it is a requirement to work horses in a flexed HNP, such as in dressage [26]. Research has shown that when given the choice, horses preferred the IFV to the BTV HNP [12], probably due to distress or discomfort experienced when ridden in a BTV HNP, and there is substantial evidence indicating compromised welfare of equids ridden in the BTV HNP [12,27-29]. For instance, exercising horses in a flexed HNP reduces the dorso-ventral diameter of the nasopharynx [13] and increases the risk of developing upper respiratory tract obstructions during peak exercise [13,30]. In another study, exercising horses in hyperflexed HNPs presented with increased equine stress responses, reflected in increased heart rate variability [11,12], which has been shown to be a reliable indicator of stress in horses [31,32]. Behaviours indicative of conflict such as tail swishing,

abnormal oral behaviour, ears fixed back, attempted bucks, were significantly more often recorded in horses ridden in a hyperflexed HNP, and those horses also reacted more fearfully to novel or frightening stimuli [12], potentially due to the loss of forward vision [22]. Therefore, hyperflexion appears to increase the occurrence of equine behaviours suggesting distress and compromised welfare [9,10,12].

The International Equestrian Federation's (FEI) dressage rules stipulate that "Abuse of a Horse using natural riding aids (...) will not be tolerated." [26 p.7]. Yet, there is evidence of horses displaying distress reflected in behaviours indicative of conflict in warm-up arenas as well as in competition rings, particularly at high level competitions which has been reported both anecdotally and within literature [10]. The FEI rules also state that show horses expressing behaviours indicative of conflict suggest compromised welfare. Therefore, stewards and other show officials are required according to the rules to address this issue when observed in warm-up rings. As stated by the FEI dressage rules, judges are expected to mark down 'incorrect' HNPs, yet, particularly at high level shows BTV HNPs seemed to have been 'tolerated' by show officials [10]. Wolframm, Schiffers and Wallenborn [33] determined by employing eye-tracking technology that judges' focus is laid on the forelimb rather than on the HNP, which might explain why 'incorrect' BTV HNPs are not necessarily penalised in the show ring. Nevertheless, it remains uncertain why, despite research indicating compromised welfare and FEI rules clearly suggesting what correct HNPs constitute, horses are still allowed to be warmed up and competed BTV.

Ignoring the principles of learning theory [22] by 'forcing' the horse to obtain a flexed or BTV HNP, contrary to the definition of self-carriage, may falsely suggest talent for dressage to potential buyers and misleadingly present a horse as well-schooled. Indeed, findings of one study have shown that BTV HNP was the most frequent (70%) HNP recorded and associated with higher horse training levels in UK horse sales advertisements [34]. Therefore, BTV HNPs might epitomise a misperception among equestrians of horses working in a correct outline. The tack type (e.g. saddle type) selected in advertisements may also

misleadingly suggest talent for or experience in a certain discipline and could increase vendors' chances of sale. It appears that BTV HNPs are still seen as aesthetic, and perhaps correct in terms of training, by a larger proportion of the equestrian population, despite research indicating compromised welfare. Research-based information is highly valued by a proportion of the equestrian community [35], yet, implementing research findings in daily practice is often inhibited by resistance to change [36], traditions, and, perhaps, economic disadvantages. It seems that the practice of schooling horses with their noseline behind the vertical remains a common sight in equitation, particularly at disciplines where flexing the horse head and neck is required in competition.

The current scientific literature lacks quantification of whether riders' preferences of HNP have changed over time. To address this, sales advertisements in the Australian Horse Sales magazine *Horse Deals* were analysed to determine potential longitudinal/chronological changes in HNP preferences. Vendors advertising their horses in the magazine present a snapshot of the social demographics of the Australian horse sector at the given years and reflect the different segments of the horse industry. Like McGreevy, Harman, McLean et al. [22], we surmised that vendors would select photographs that depicted the horse for sale in the best possible aesthetic (in their opinion) to get the advertised price.

The primary objective of this study was to explore potential differences in depicted HNPs between the years 2005 and 2018. Other factors potentially impacting HNPs were also investigated.

2. Materials and methods

Three issues of a popular Australian horse sales magazines (*Horse Deals*, South Australia), one from the year 2005 (the year when the first International Equitation Science Symposium was held) and two from 2018 (representing the status quo), were obtained. Since the total number of horse advertisements was lower in the 2018 issues compared to the 2005 issues, two issues from 2018 (October and November

2018) were randomly selected to collect two comparable data sets with similar population sizes from each tested year (April 2005 and October/November 2018). Magazine advertisements were chosen and included in this study if they met the research inclusion criteria (Table 1). The sample population (n) comprised 570 horse advertisements: 303 advertised in April 2005 and 267 advertised in October and November 2018.

Table 1: Research inclusion and exclusion criteria applied to select advertised photographic images

Inclusion criterion	Definition (explanation)
<i>Horses were ridden</i>	Horses were depicted with a mounted rider
<i>Horses were traveling</i>	Horses were traveling/moving in either walk, trot, or canter/gallop when the photograph was taken (the gait was identified based on the horse's feet arrangement and location on/above ground)
<i>Horses wore headgear including a bit (mouthpiece)</i>	Horses were depicted wearing headgear (e.g. a bridle) and one/two bit(s) in their mouth
<i>Horses wore a saddle</i>	Horses were depicted wearing a saddle and saddle type could be clearly identified on the photograph
<i>HNP was clearly visible</i>	Horses' HNPs could be seen clearly in the advertised photographs to apply protractor to categorise HNP
Exclusion criterion	Definition (explanation)
<i>HNP not clearly visible</i>	Photograph angle did not allow application of triangle ruler to apply HNP categorisation criteria
<i>Horses not traveling</i>	Horses depicted not traveling, i.e. at halt/resting; all four feet were on the ground
<i>Headgear not clearly visible</i>	Horses' headgear/bit type could not clearly be identified due to photograph angle/clarity
<i>Horse jumping an obstacle</i>	Horses were depicted jumping an obstacle
<i>Saddle type not clearly visible/identifiable</i>	The saddle type could not be clearly identified on the photograph
<i>Unridden horses</i>	All horses without a mounted rider
<i>Horses ridden bitless</i>	All horses depicted without a bit (mouthpiece)

For each photograph that met the research inclusion criteria, the location of the noseline (i.e. formed by an imaginary line located between the horse's forehead, i.e. skull, and tip of the nasal bones above the nostrils) was measured relative to an imaginary vertical line to the ground (Figure 2) to determine the HNP using a protractor. HNP was categorised as behind-the-vertical (BTV), on-the-vertical (OV), slightly-

in-front-of-the-vertical (IFV), or extremely-in-front-of-the-vertical (EIFV), comprising any HNP $>30^\circ$ IFV (Figure 3). Horses that were ridden on a long rein or with 'loose' contact (e.g. where the rider did not ride the horse with a shortened rein that could have impacted on the horse's natural HNP) were included in the EIFV category.



Figure 2: Location of noseline relative to a vertical line to the ground (weight-bearing/ground-contact surface); Noseline Angle (NoA) in degrees was measured relative to a vertical line to the ground to categorise HNP

BTV

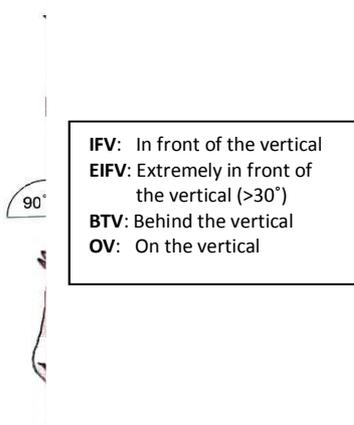


Figure 3: Different head and neck positions (HNPs) used to categorise sample HNPs

2.1 Data categorisation

Horses were categorised according to the magazine classification they were advertised in for either horse breed, job, or discipline, e.g. quarter horse, off-track thoroughbred, western, eventer, performance. Due to the large number of separate horse categories listed in the magazine and the large differences in horse numbers within those categories, magazine categories were summarised based on similarities between listed uses, riding disciplines and/or breeds (Table 2).

Table 2: Summarised horse categories and corresponding magazine categories

Summarised category	Individual categories listed in magazine
<i>WESP</i>	Warmblood/baroque horses Eventer Show Performance
<i>WWAAQC</i>	Western Working Australian stock horses Arabian & endurance Quarter horses Coloured breeds
<i>PAO1</i>	Ponies Allrounders Off the track Under \$1000

Previous studies reported that equestrians perceive BTV HNP in sales advertisements as indicators of advanced training [34] and a cohort of younger and less experienced equestrians preferred BTV over IFV HNPs in horses in general [37]. It has been argued that head and neck angle and vertical neck displacement in unriden horses at liberty alters depending on the gait and speed traveling [38]. Riding horses with BTV HNPs is a common observation at competitions [10], particularly in disciplines where riding horses in flexed HNPs is required, such as in dressage. Further, certain noseband types, such as the flash and drop nosebands, have shown to exert higher pressure on the horse's nasal bones compared to the cavesson noseband [39]. Horses fitted with a tight noseband needed even lower bit

pressures to react to the rider's rein aid [40,41] and, due to this, horses may try avoiding discomfort or pain through overbending their heads and necks [23] when wearing a certain type or ill-fitted noseband in general. Therefore, factors potentially impacting observations of and changes in HNP in this study, i.e. horse category/riding discipline, horse experience level, noseband and saddle type, were selected and analysed (Table 3).

Table 3: Investigated factors (HNP, noseband, saddle type, magazine category advertised in, experience level) and corresponding factor categories applied for the analysis

Factor	Factor categories
<i>Head and neck position (HNP)</i>	Extremely in front of the vertical (EIFV) In front of the vertical (IFV) On the vertical (OV) Behind the vertical (BTV)
<i>Noseband type</i>	Cavesson (including crank nosebands) Figure eight (kineton)/flash/drop None
<i>Saddle type</i>	Dressage Jumper/all purpose Western & Stock Other
<i>Horse breed/discipline/magazine category advertised in</i>	Warmblood & baroque horses/Eventer/Show/Performance (WESP) Western/Working/Australian stock horse/Arabian and endurance/Quarter horse/ Coloured breeds (WWAAQC) Ponies/Allrounder/Off the track/Under \$1000 (PAO1)
<i>Horse experience level</i>	Experienced/competed Basic

2.2 Data Analysis

All measurements obtained through analysing the advertised photographs were transferred into a spreadsheet (Microsoft Excel 365). Data were analysed using the statistical software program SPSS (IBM Statistical Package for Social Sciences, version 22). Frequency analysis was conducted within each tested year's factors and on the total sample population. The analysed data type comprised categorical (nominal) data, hence, a non-parametric (distribution free) test was selected for data analysis. Further,

the numbers of analysed horse advertisements from 2005 and 2018 were unequal in size and from two independent sample groups, which justifies the use of the Pearson Chi-square test [42]. Post hoc testing was conducted via a multiple regression approach [43] when significant p-values were determined. Initial Pearson chi-square values were adjusted according to the Bonferroni-method [44] to avoid type-I errors (revised alphas: 3x4 contingency Tables, $P < 0.004$; 2x4 contingency Tables, $P < 0.006$). HNPs were compared between the years and factors, e.g. horse category, horse experience, noseband type. An independent proportions z-test was performed via the z-score calculator to identify potential differences in HNPs between the years. Significance levels of Pearson chi-square values of $P < 0.05$ determined significant differences between sample populations (years) and tested factors (e.g. HNP and horse category/riding discipline). We hypothesised that there would be a difference in HNP frequencies within each category between the year 2005 versus 2018.

3. Results

3.1 Distribution of HNPs

Analysis of combined data from the years 2005 and 2018 found 47 % ($n=570$) of horses were advertised with HNPs behind the vertical (Table 4). Significant differences in HNPs were observed across the categories BTV and IFV between 2005 and 2018 (Figure 4). The percentage of horses advertised with HNP BTV reduced by 13.7% from 2005 ($n=303$) to 2018 ($n=267$) ($p < 0.001$), in contrast those with HNP IFV increased by 16.4% ($p < 0.0004$). However, the number of advertisements where horse's HNP was EIFV reduced by 4.8% in 2018 ($n=267$) ($p < 0.16$) and increased by 2.1% in 2018 ($n=267$) ($p < 0.47$) where the HNP was OV.

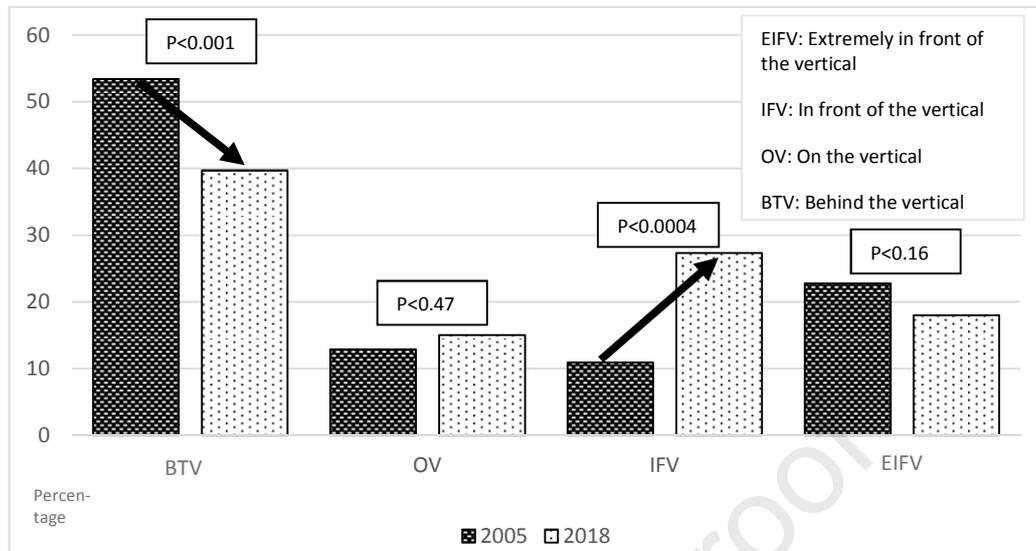


Figure 4: Comparison of HNP percentages between 2005 and 2018; the black arrows indicate significant differences between the years (corresponding p-values of HNP differences can be found above the graphs)

Table 4: Tested factors, categories within factors, distribution (percentages and counts [in brackets]) within the years (2005, 2018) and total percentage and count average (combined years)

Factor	Categories within factor	Total percentage and frequency average	Percentage and frequency in 2005	Percentage and frequency in 2018
<i>HNP</i>	Behind the vertical (BTV)	47.0% (268)	53.4% (162)	39.7% (106)
	On the vertical (OV)	13.9% (79)	12.9% (39)	15.0% (40)
	In front of the vertical (IFV)	18.6% (106)	10.9% (33)	27.3% (73)
	Extremely in front of the vertical (EIFV)	20.5% (117)	22.8% (69)	18.0% (48)
<i>Horse category</i>	Warmblood/Eventer/Show/Performance (WESP)	46.8% (267)	63.0% (191)	28.5% (76)
	Western/Working/Arabian/Austr.Stock/Quarter/Coloured Horse (WWAAQC)	11.8% (67)	7.6% (23)	16.5% (44)
	Ponies/Allrounder/Off-Track/Under \$1000 (PAO1)	41.4% (236)	29.4% (89)	55.1% (147)
<i>Experience</i>	Experienced/competed	57.1% (331)	72.9% (221)	41.2% (110)
	Basic	42.9% (239)	27.1% (82)	58.8% (157)
<i>Noseband</i>	Cavesson (including crank)	54.2% (309)	52.1% (158)	56.6% (151)
	Figure8(kineton)/drop/flash	31.4% (179)	41.9% (127)	19.5% (52)
	None	14.4% (82)	5.9% (18)	24.0% (64)
<i>Saddle</i>	Dressage	67.4% (389)	84.8% (257)	47.6% (127)
	Jumper	15.8% (89)	7.6% (23)	25.1% (67)

Western/Stock	15.4% (84)	7.6% (23)	24.3% (65)
Other	1.4% (8)	0% (0)	3.0% (8)

3.2 Distribution of horse categories/riding disciplines and HNPs

Analysis of combined data from the years 2005 and 2018 found 46.8% (n=570) of horses were advertised in the WESP, 41.4% (n=570) in the PAO1 and 11.8% (n=570) in the WWAAQC category (Table 4). The percentage of horses advertised in the WESP category reduced by 35.5% ($p < 0.0005$) from 63% (n=303) in 2005 to 28.5% (n=267) in 2018 (Figure 5). However, the percentage of horses advertised in the WWAAQC category increased by 8.9% ($p < 0.001$) from 7.6% (n=303) in 2005 to 16.5% (n=267) in 2018. The number of advertisements in the PAO1 category increased by 25.7% ($p < 0.0004$) from 29.4% (n=303) in 2005 to 55.1% (n=267) in 2018. Pearson chi-square and post-hoc testing revealed that of those horses ridden in a BTV HNP, significantly more, i.e. 57.84% (n=268), were advertised in the WESP category ($p < 0.0004$). Of those horses ridden EIFV, significantly less, i.e. 25.64% (n=117), were listed in the WESP category ($p < 0.0002$). On the contrary, of all horses ridden BTV significantly less, i.e. 5.22% (n=268), were listed in WWAAQC ($p < 0.002$). The number of horses advertised BTV in the WESP category reduced by 36.4% ($p < 0.0004$) from 72.2% (n=162) in 2005 to 35.8% (n=106) in 2018.

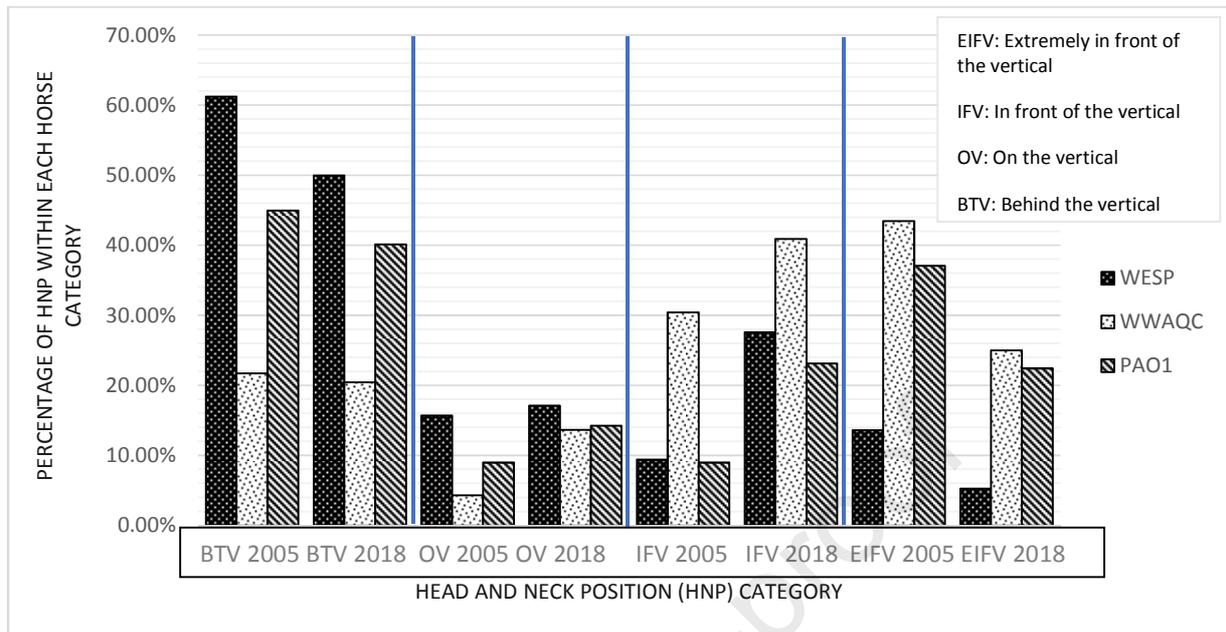


Figure 5: Distribution of head and neck position categories (BTV, OV, IFV, EIFV) within each horse category (WESP, WWAAQC, PAO1) and year (2005, 2018)

3.3 Distribution of horse experience categories and HNPs

Analysis of combined data from both years found 57.1% (n=570) of horses were advertised as experienced or competed and 42.9% (n=570) were advertised as having received basic training (Table 4). The percentage of horses advertised as experienced/competed reduced by 31.7% from 72.9% (n=303) in 2005 to 41.2% (n=267) in 2018 and the percentage of horses advertised with basic experience increased from 27.1% (n=303) in 2005 to 58.8% (n=267) in 2018 ($p < 0.0004$). Post-hoc testing showed no significant differences between HNP and horse experience on combined data and between the individual years.

3.4 Distribution of noseband types and HNPs

Analysis of combined data from both years, showed 54.2% (n=570) of horses were ridden with a cavesson, 31.4% (n=570) in either a figure eight (kinton), drop, or flash noseband, and 14.4% (n=570) were ridden without a noseband. In 2018, the number of horses ridden with a cavesson increased by 4.5% from 52.1% (n=303) in 2005 to 56.6% (n=267) (Figure 6). The number of horses advertised with a

figure eight, drop, or flash noseband reduced from 41.9% (n=303) in 2005 to 19.5% (n=267) ($p<0.0004$), whereas the number of horses ridden without a noseband increased from 5.9% (n=303) in 2005 to 24.0% (n=267) in 2018. Those ridden without a noseband were the lowest number (6.34%) of all horses presented BTV (n=268) ($p<0.0004$).

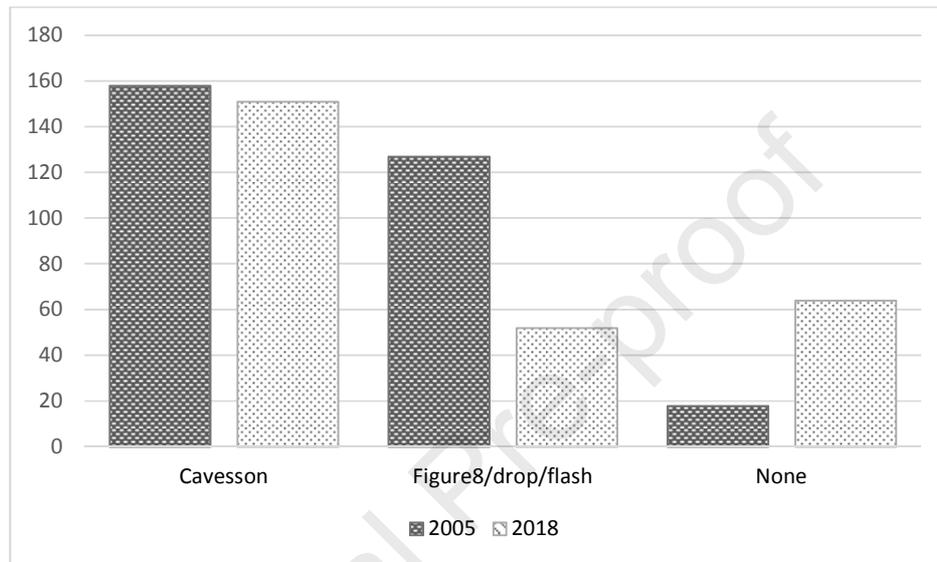


Figure 6: Comparison of noseband type frequencies depicted in advertisements in 2005 and 2018

3.5 Distribution of saddle types and HNPs

Analysis of combined data from 2005 and 2018 revealed that 67.4% (n=570) of all advertised horses were ridden in a dressage saddle, 15.8% (n=570) were ridden in a jumper saddle, 15.4% (n=570) were ridden in a Western or Australian Stock saddle, and 1.4% (n=570) were ridden in another saddle type. The percentage of horses ridden in a dressage saddle reduced by 37.2% from 84.8% (n=303) in 2005 to 47.6% (n=267) in 2018 ($p<0.0004$). The frequency of horses ridden in a jumper saddle increased by 18.5% from 7.6% (n=303) in 2005 to 25.1% (n=267) in 2018 ($p<0.0004$). In 2018, 16.7% more horses, i.e. 24.3% (n=267), were advertised in a Western or Stock saddle compared to 7.6% (n=303) in 2005 ($p<0.0004$), and 3% (n=267) of horses were advertised in another saddle type in 2018 compared to none

in 2005. Of all horses depicted BTV, 79.48% (n=268) were ridden in a dressage saddle ($p<0.0004$) and 7.09% (n=268) were ridden in a Western or Stock saddle ($p<0.0051$).

4. Discussion

This study explored head and neck positions based on ridden horse advertisements in an Australian horse sales magazine of the years 2005 versus 2018. A large proportion of horse vendors (47%) in 2005 and 2018 combined used photographs depicting their advertised ridden horses with a behind the vertical (BTV) HNP. Despite BTV still remaining prominent among vendors in 2018 (39.7%), these findings show a reduction of BTV HNP prevalence compared to previous research conducted by McGreevy, Harman, McLean et al. [22] and Hutchings and Randle [34] who reported that 68% and 70% of sampled horses, respectively, were depicted in the BTV HNP. In contrast to the observations above, Caspar, Dhand and McGreevy [37] explored human preferences for certain HNPs and reported that only 7% of the participants in their study cohort preferred the BTV HNP. When comparing BTV HNP prevalence in Australian advertisements in 2005 to findings based on advertisements from 2009 [22], BTV HNP prevalence increased by 14.6% to 68% in 2009 compared to 53.4% in 2005. The debate around hyperflexion began shortly after the first equitation science symposium was held in 2005 and led to the FEI round table conference in 2010 where the Rollkur training method was officially banned at FEI competitions [16]. In the following decade, impact of hyperflexion on horse welfare has been scrutinised and publicly debated by the scientific [12,27,28] and non-scientific community. This may have contributed to the significant reduction in BTV HNP from 53.4% in 2005 to 39.7% in 2018 ($p<0.001$) and suggests that initiatives to educate equestrians about incorrect HNP may have experienced a certain level of success. However, when considering the chronological reduction in BTV HNP prevalence based on the findings of above studies, the overall development may be carefully interpreted as sign of a positive shift towards 'correct' HNP preferences among equestrians.

Previous work suggests BTV HNP is perceived as an indicator of more advanced training levels by horse buyers in advertised sales of horses [34], and therefore, it might be possible to surmise that BTV HNP is favoured by vendors as an indicator of the training level of the advertised horse. The results of this study show a large proportion of horses advertised in magazine categories in which working a horse in a flexed HNP was common were advertised with BTV HNPs. Indeed, BTV was observed as the main HNP (57.84%) in the WESP category ($p < 0.0004$). Horses listed in this category were predominantly dressage, jumper, eventing, or other show horses. However, the reduction of BTV HNP in the WESP category by 36.4% in 2018 compared to 2005 could possibly indicate that vendors' and, consequently, equestrians' awareness of 'correct' HNP may have increased over those thirteen years. Nevertheless, the practice of dorso-ventrally overbending horses' heads to different degrees during warm-up or cool-down remains permitted at shows in the warm-up ring according to FEI rules [17,26] and presents a serious welfare concern [29].

Moreover, the decrease of horses listed in the WESP category in 2018 may also have contributed to the reduced prevalence of BTV HNP in 2018 compared to 2005. Horses competing in the WESP disciplines are required to work in a flexed HNP in front of but close to the vertical [26]. Yet, there seems a strong discrepancy between the ideal position of the noseline in front of the vertical, as advocated by FEI rulebooks and national riding manuals, and the favoured HNP by vendors in this study, which was BTV. This is confusing, however, since BTV HNP is considered incorrect or undesirable for disciplines competing under FEI guidelines [26] and should be penalised in dressage tests. Paradoxically, BTV HNPs are being rewarded at dressage shows [10], particularly at advanced levels. The intent and philosophy of the FEI guidelines is that training will create "happy athletes" [26 p.9] with the welfare of the horse being paramount [26]. However, our findings, in addition to those of other researchers [10], demonstrate that BTV HNP prevalence, although not significant, increased with competition/show experience of the horses, highlighting a potential disconnect between training goals, equine well-being

and FEI welfare goals. It has been suggested that the prevalence of BTV HNP observed in sales advertisements could represent a lack of understanding of HNP in relation to equine well-being and compromised welfare [9,12,27,28]. Since BTV HNP is frequently observed among show riders of all levels, particularly in the discipline of dressage, vendors may choose to advertise their horses BTV. Therefore, equestrians may interpret BTV HNP as an indicator of advanced training in sales horses, which was also recorded in another UK-based study [34]. This misperception among equestrians may increase vendors' chances of sale and attract more buyers and could possibly explain why vendors chose to advertise photographs depicting their sales horses BTV.

Training and competition experience of sales horses in our study did not impact on the prevalence of BTV HNP at different horse training or experience levels, i.e. frequency of BTV HNP did not reduce with increased training or show experience of the horse. Indeed, competing at advanced levels was linked to a higher prevalence of BTV HNP in another study, which was not penalised by judges despite being contrary to FEI recommendations [10]. Yet, vendors' advertised photographs only provide a snapshot of a horse and the reasons behind selecting a BTV HNP could be purely based on personal aesthetics or preferences [22]. Nevertheless, BTV HNP may be misinterpreted by both, vendor, and potential buyer, as an indicator of a horse working in self-carriage at advanced level [34] and willingly taking contact with the rider's hands, perhaps promising talent for the discipline of dressage, which may increase the vendor's chances of sale and attract more buyers.

Further, choosing a particular saddle type in sales advertisements may suggest specialisation of the horse in the corresponding riding style, e.g. a potential buyer may assume that the horse is experienced in or, perhaps, more suitable for the corresponding discipline. The high prevalence of BTV HNP in horses advertised in dressage saddles when compared to any other saddle type may present another misperception among vendors and buyers of horses showing talent for dressage and working at advanced training levels [34] since working horses in a flexed HNP is required in dressage tests.

Nevertheless, it remains questionable if riders, trainers, and show officials are aware of what a correct HNP constitutes according to the rules. This notion is debatable since BTV HNPs were penalised at lower but not at the more advanced competition levels [10]. It may be argued that awareness of correct HNPs exists among at least some show officials, which may explain why the prevalence of BTV HNP in horses advertised in the WESP category significantly reduced from 2005 versus 2018. However, this observation remains confusing since the presence of more experienced, highly trained, and informed riders, coaches, and show officials alike at advanced shows did not reduce the prevalence of false (BTV) HNPs [10]. It seems that, also based on other researchers' findings [10], experience may not necessarily contribute to presenting horses in a HNP that is deemed 'correct' according to official guidelines. Still, evaluating equestrians' knowledge of HNP based on a single photograph remains impossible. It also remains uncertain if, despite perhaps possessing the theoretical knowledge of what correct HNP constitutes, equestrians will be able to translate this knowledge into a practical training context.

The BTV HNP was significantly less often exhibited in horses ridden without a noseband. Nosebands are mandatory in some competitive equestrian disciplines, such as dressage, and previous research has shown that noseband fit and tightness can impact HNP. Horses fitted with a tight noseband required even lower bit pressures to react to the rider's rein aid [40,41], and actively elected to avoid pressure exceeding their pressure threshold [45]. When wearing a tight noseband, a horse is prevented from opening his mouth and cannot avoid bit pressure exerted by the rider's hands via the reins [46]. In dressage tests, open horse mouths are considered a sign of resistance and judges may reflect this observation in lower marks [26]. Therefore, preventing a horse from opening his mouth by using a tight noseband may help riders/vendors gain a competitive advantage and mask incorrect training techniques and, consequently, pain in the horse. Indeed, BTV HNP has been linked to an increased prevalence of behaviours indicative of conflict [10], such as abnormal oral behaviours (e.g. chewing with an opened mouth). A study involving a cohort of 2-year-old horses recorded that the animals learned to evade rein

tension by overbending their heads and necks [45]. This avoidance behaviour might explain the high incidence of BTV HNP in ridden horses wearing nosebands in disciplines where flexed HNPs are required, such as WESP horses. When horses avoid 'contact' by obtaining a BTV HNP the rider has probably exceeded the horse's rein pressure threshold. If this is the case, it seems that some riders and trainers fail to make subtle cuing their main training goal [46], which may present a welfare concern [47] and one possible explanation for the prevalence of BTV HNP in advertised horses.

Festinger [48] proposes in his cognitive dissonance theory that actual human behaviour often does not match their stated beliefs. When this happens, humans can enter a state of cognitive rigidity, where pre-existing beliefs and attitudes are maintained despite scientific evidence indicating otherwise, ultimately preventing attitude and behaviour change. This observation may potentially explain why BTV HNP are still preferred by some cohorts within the equestrian community regardless of their welfare compromising effects. However, studies have shown that cultural ideologies and attitudes can change over time and result in rejection of formerly accepted behaviours and concepts [49]. Education as well as public acceptance and public implementation of new practices and beliefs by governing and authoritative bodies were some factors shifting mainstream attitudes and views over time [50]. This approach could be used as a benchmark to further facilitate change within the equestrian culture.

Limitations: Since a non-matched research design was employed, the randomly selected magazine issues (April 2005 and October/November 2018) may have influenced the numbers of horses advertised in each magazine category, which may have impacted on the overall comparison of distributions between the years. Although it was assumed that vendors selected photographs that showcased their horses to their best abilities, photographs depict just a moment in time. Therefore, drawing conclusions about the quality of overall training based on a photograph alone remains impossible. Furthermore, no distinction was made between HNP just slightly behind the vertical and more extremely and hyperflexed BTV HNPs;

this approach was applied as in training and competition, all HNP BTV are not desired at any training stage and present a fault in dressage competitions.

5. Conclusion

The percentage of horses being advertised for sale with an image containing HNP BTV has reduced significantly from 2005 to 2018 in Australia. Increased numbers of advertisements featured horses with HNP BTV in equestrian disciplines where the horse is worked in a flexed HNP referred to as 'on-the-bit' although BTV HNP is deemed incorrect according to official guidelines. Vendors and buyers may consider BTV HNP as more aesthetic and misinterpret BTV HNP as an indicator of advanced training. The results indicate that there may be a need for further educational interventions about the harmful effects of BTV HNP to safeguard equine welfare.

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Highlights:

- Behind-the-vertical (BHV) head and neck position prevalence reduced in 2018 compared to 2005
- 47% of vendors used photos depicting their horse in BHV head and neck position (HNP)
- BHV HNP was mainly observed in the warmblood/eventers/show/performance horse category
- HNP was not linked to training/experience level of the advertised horse

Author statement

Tanja Bornmann: Conceptualisation, methodology, formal analysis, investigation, resources, writing - original draft preparation, writing – reviewing and editing, visualisation.

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