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## EFFECTS OF VARIOUS HOUSING SYSTEMS ON THE DEVELOPMENT OF EQUINE BEHAVIOR IN THOROUGHBRED HORSE PAKISTAN

Abdul Saleem Alias Baboo, Muhammad Naeem\*, Atique Ahmed Behan, Nasir Rajput,  
 Noor -un-Nisa Marri, Shakeel Ahmed Tunio, Shahrood Ahmed Siddiqui

Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University, Tandojam

\*Corresponding author: [mnrajput@sau.edu.pk](mailto:mnrajput@sau.edu.pk)

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### ABSTRACT

The study was conducted to investigate the impact of various housing systems on the development of equine stereotypies. N=120 x Thoroughbred Pakistan of three different groups (A=40 horses 2years not gelded, B= 40 age 3 years and C= 40 four years gelded) were kept in four distinct types of housing systems, (SHSNI) Single Housing System No Interaction, (SHSLI) Single Housing System Limited Interaction, (DHS) Double Housing System and (GHS) Group Housing. The study was conducted in four phases (Phase-I SHSNI, Phase-II SHSNI, Phase- III DHS and Phase- IVGHS were used) and each phase was comprised of 30 days duration. On every 10<sup>th</sup> day parameters were recorded, and three readings were recorded in every housing system. A comprehensive set of 12 readings recorded through video recording, personal observation and information provided by horse handlers and randomized complete block design was performed for statistical analysis. Housing systems had significant ( $p<0.05$ ) impact on the development of stereotypies. The highest incidence of stereotypies 35.83% was found in SHSNI, followed by 29.13% in DHS, 18.31% in GHS and the lowest 16.63% in SHSLI. The maximum number of horses displayed weaving (7.29%), behavior followed by kicking (6.45%), biting (6.03%) and crib-biting (5.83%). The groups (non-gelding and gelding) were found non-significant ( $p>0.05$ ). The study concludes that SHSLI is more suitable needed to be adopted, system has necessary social interaction, less stereotypies with limited injuries as compared to alternative housing systems.

**KEY WORDS:** Thoroughbred Horse, Stereotypies, Housing system, Biting, Kicking

### INTRODUCTION

Archaeological and paleontological studies, as indicated by Teletchea (2019) and Levine (1999), suggested that the initial steps towards domestication began approximately 12,000 years ago. Librado *et al.* (2017) investigated on domestication and found evidence that around 5000-6000 years BC in the region of Deverika, Ukraine, horses were first systematically domesticated primarily for meat consumption, eventually expanding to include milk production as well. Prior to their domestication, horses typically lived in small groups of 3-10 individuals, known as Harem or Dyadic social bands, as described by Feh (1999) and Bourjade *et al.* (2009). These groups exhibited intense social interactions and enjoyed a significant degree of freedom of movement, as noted by Rivera *et al.* (2002). In such social structures, horses functioned as group-living equids, employing collaborative strategies to protect themselves against predators, as outlined by Waring (2003).

The process of domestication led to horses being housed in confined environments such as loose boxes, stalls, barns, and shelters. This approach aimed to simplify their management and protect them from various potential health and welfare risks. However, domestication has had some unintended consequences,

compromising the natural behaviors and social communication that horses enjoyed in their wild state, as noted by Mills *et al.* (2002). Domestic horses, scientifically known as *Equus Caballus*, are inherently social and free-ranging herbivores. Their natural inclination is to form close-knit herds with extensive social interactions, as described by Cooper & Mason (1998), Linklater *et al.* (2000), Waring (2003), and Sarrafchi & Blokhuis (2013). Horses are often referred to as trickle feeders, as they graze for 16-18 hours a day, according to research by Keiper (1986), Goodwin *et al.* (2005), and Molle *et al.* (2022). During this time, they spend a significant portion, approximately 80% of their day or waking hours, engaged in both movement and grazing on grass as a united group, as documented by Mills & Nankervis (2013) and Molle *et al.* (2022).

In modern equine husbandry practices, the single housing system has become predominant, with horses being kept individually. However, this approach exposes horses to both confinement and social isolation, as highlighted by Cooper *et al.* (2000) and Benhajali *et al.* (2010). The consequences of this confinement, lack of social interaction, and limited mobility are considered significant contributing factors to boredom, frustration, and stress in stable horses. These factors can potentially serve as underlying causes for the development of

stereotypic behaviors among horses kept in such conditions, as suggested by McGreevy *et al.* (1995), Cooper & Mason (1998), Nicol (1999), Rivera *et al.* (2002), and Lundqvist & Muller (2022). While modern equine husbandry practices focus on safeguarding horses from extreme weather conditions, predators, hunger, physical injuries, and discomfort, they often overlook the psychological well-being of these animals in the man-made environment. This neglect of psychological factors, as noted by Hughes & Duncan (1988), can have detrimental effects on the mental health and welfare of horses.

Stereotypies in horses can be defined as repetitive, purposeless movements involving various body parts such as the oral, head, limbs, and the entire body. This behavior lacks a clear and obvious goal, as noted by McBride & Hemmings (2009), Sarrafchi & Blokhuis (2013) and Plato (2022). Equine stereotypies, or abnormal behaviors, can generally be categorized into two main groups, with potential involvement of different body parts: locomotive stereotypies, which include behaviors like kicking, weaving, pawing and stall walking and oral stereotypies, encompassing actions such as biting, crib-biting, and wood chewing as described by Mills *et al.* (2002), McDonnell (2003) and Meija (2022). Stereotypies are generally considered undesirable due to their harmful effects on horses. These effects may include uneven development of muscles, weight loss, an aesthetically displeasing appearance and a negative impact on performance and longevity, as highlighted by Cooper & Mason (1998). Stereotypies can also diminish the economic value of a horse and are sometimes regarded as an unsoundness, as noted by McBride & Hemmings (2009) and Albright *et al.* (2009). Currently, stereotypies pose significant challenges in modern husbandry and are directly linked to the psychological welfare of stabled horses. It is widely believed that modern husbandry practices have a substantial influence on the development of stereotypical behavior patterns in horses kept in stable environments, as discussed by Houpt & McDonnell (1993), McGreevy & Nicol (1999), and Parker *et al.* (2008).

Stereotypies are commonly recognized as strong indicators closely linked to suboptimal and inadequate stabling environments. Due to this association, stereotypies are often referred to as stable vices or diseases of domestication, as emphasized by McGreevy & Nicol (1998), Marsden (2002), Sarrafchi & Blokhuis (2013) and McDonnell (2022). The captivity and confinement of animals can lead to the development of stereotypic behaviors in various species, such as tongue rolling in cows, bar biting in sows, and object licking in giraffes, as observed in studies by Mason (1993), Rushen & Mason (2006), and Stewart *et al.* (2017). These behaviors are indicative of the negative impact of captivity on the welfare and psychological well-being of animals across different species.

## MATERIALS AND METHODS

The research was carried out at Remount Depot Mona, located in Mandi Bahauddin, Punjab, Pakistan, established back in 1902 and renowned as the "Home of Horses." The study involved a sample size of N=120 Thoroughbred Pakistan (TBP) horses, divided into three distinct groups: Group A consisted of 40 non-gelded 2-year-old horses, Group B included 40 horses aged 3 years, and Group C comprised 40 four-year-old gelded horses. These horses were subjected to four different housing systems: (1) Single Housing System No Interaction (SHSNI), (2) Single Housing System Limited Interaction (SHSLI), (3) Double Housing System (DHS), and (4) Group Housing System (GHS) various housing systems are depicted in Figure 1. The study spanned 120 days, divided into four phases, each lasting 30 days as shown in Table-1. In each phase, one housing system was employed, sequentially: Phase-I SHSNI, Phase-II SHSNI, Phase-III DHS, and Phase-IV GHS. Data collection occurred at regular 10-day intervals throughout the study, utilizing a combination of video recording, direct team observation, and information provided by the horse caretakers (Grooms). A total of 12 recordings were obtained for each horse across the four housing systems. The data collected were then organized in Excel sheets based on their respective groups and various parameters were calculated as percentiles. For the statistical analysis, a randomized complete block design was utilized to account for group variations. SPSS Software, as described by Schork and Remington (2000), was employed for conducting statistical analysis. The results of the statistical analysis, including the effects of housing systems, age groups, and the development of stereotypies, are summarized in Table-2,3 & 4.

## RESULTS

Grouping was done to find significant comparison of development of stereotypies in different age groups. Different age groups were not found statistically significant ( $P>0.05$ ). The housing systems were found significantly different from one another in developing stereotypies ( $P<0.05$ ). Mean comparison test revealed the significant difference between SHSNI and SHSLI in developing stereotypies. However, the developed stereotypies in SHSNI were not statistically significant than DHS, while there was significant difference between the SHSNI and GHS. SHSLI was found statistically significant than DHS, while there was no significant difference from GHS. DHS and GHS were also found significantly different from one another in developing stereotypies. The stereotypies were not found statistically different. However, the housing systems significantly affected the development of stereotypies. In overall prevalence weaving was found to be most prevalent followed by kicking, biting and crib biting. Phase based prevalence of stereotypies is shown in in figure 3. Keeping in view the blocking in group the percentage of overall stereotypies developed in different age groups is shown in figure 4. The graphical

presentation of developed stereotypies in different housing system is shown in figure 5.

**Phase-I (SHSNI was used):** N=120 horses were kept individually with no social contact in 120 x single units of SHSNI for 30 days. Stereotypies were seen in 43 horses out of 120 horses. The prevalence of stereotypies was 35.83% (11 x horses displayed kicking 9.16%, 11x horses displayed biting 9.16%, 15x horses displayed weaving 12.5% and 7 x horses shown crib-biting 7.5%). The prevalence in group A= 35% (14 x horses displayed out of N=40), group B= 32.5% (13 x horses displayed out of N=40) and group C= 40% (16 x horses displayed out of N=40) were observed as data shown in **Error! Reference source not found.** These findings provide a detailed picture of the prevalence and specific types of

stereotypic behaviors observed during Phase-I in the SHSNI housing system, as well as variations among different age groups within this system.

**Phase-II:** N=120 horses were kept individually with limited social contact in 120 x single units of SHSLI for 30 days. Stereotypies were seen in 20 x horses out of N=120. The prevalence was 16.66% (4x horses displayed Kicking 3.3%, 3x horses displayed biting 2.5%, 6x horses displayed weaving 5% and 7x horses displayed crib-biting 5.83%). The prevalence in group A= 17.5% (7 x horses displayed out of N=40), group B= 15% (6 x horses out of N=40) and group C 17.5% (7 x horse out of N=40) were observed as data shown in **Error! Reference source not found.**



Figure.1 Various Kinds of Stereotypies A) Crib- biting; B) Biting; C) Weaving; D) Kicking

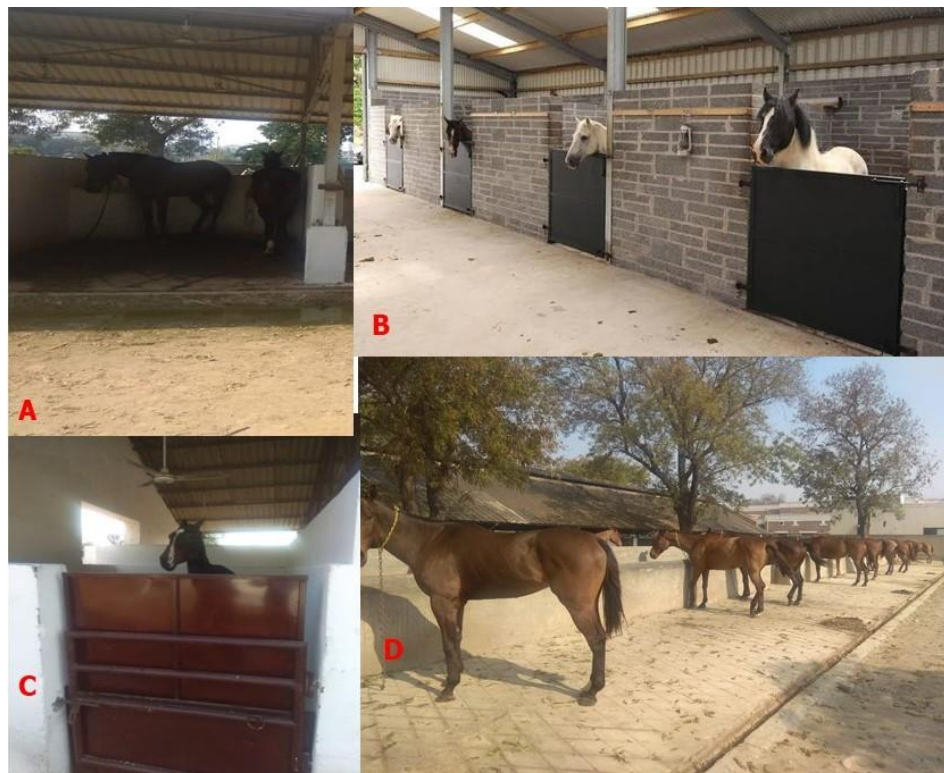


Figure-2. Different Housing Systems A) SHSNI; B) SHSLI; C) DHS; D) GHS

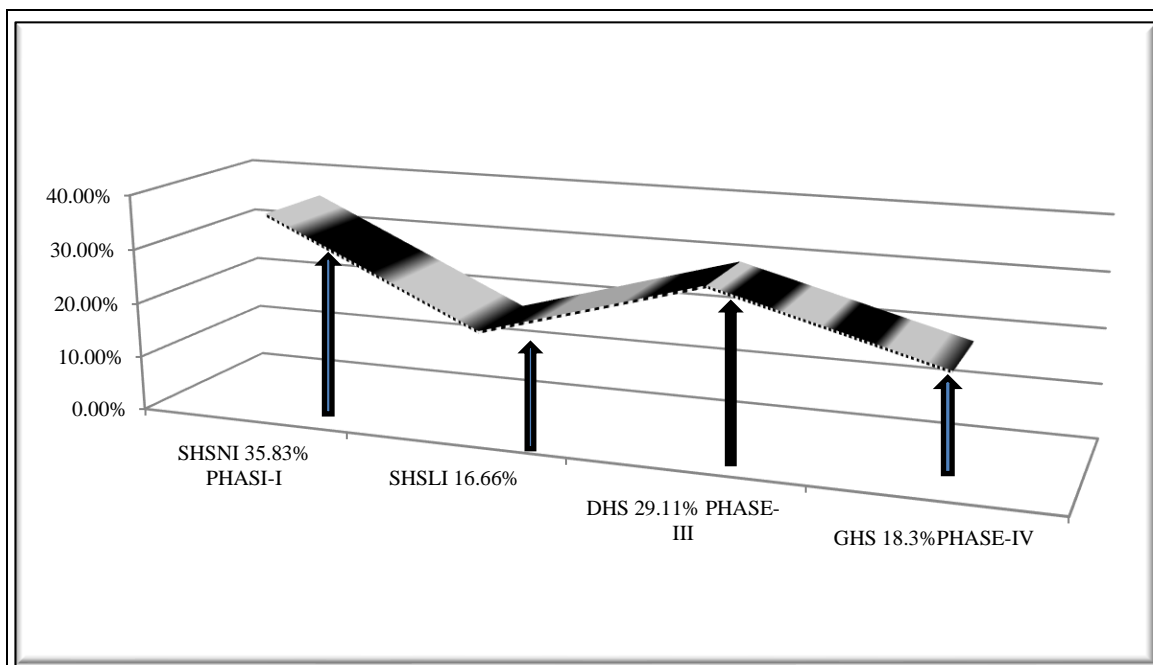


Figure-3. - Prevalence of abnormal behaviour in different housing systems

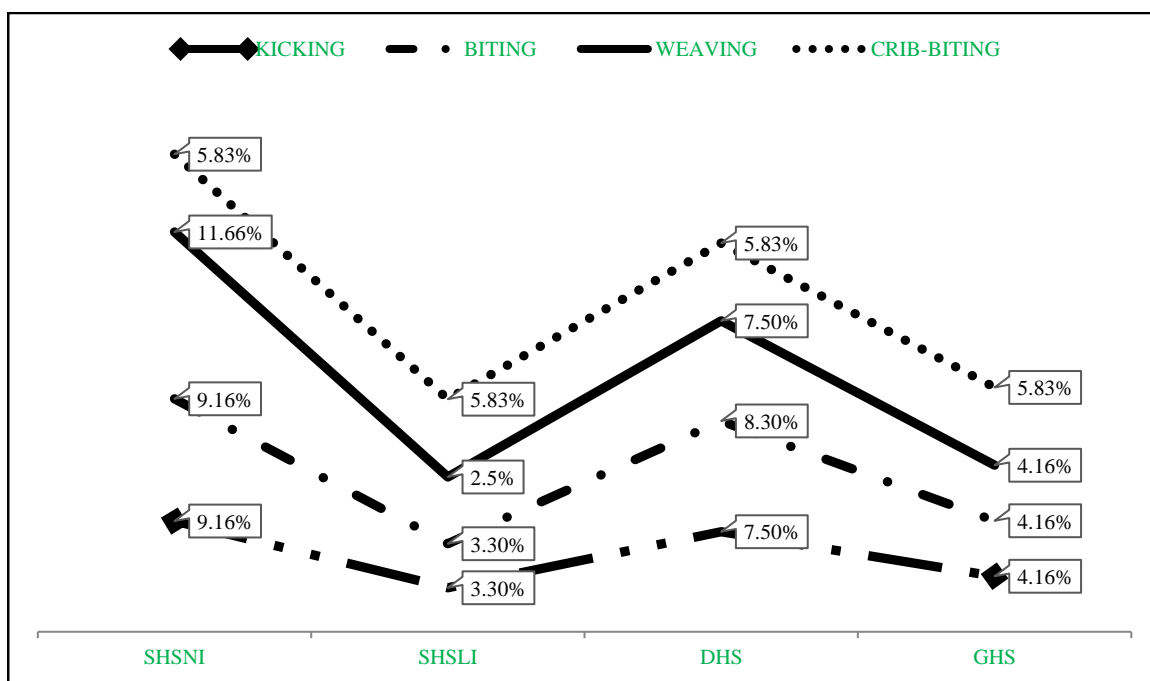


Figure- 4 Stereotypies prevalence in different housing systems

**Phase-III:** N=120 horses were kept in pairs with complete social contact in 60 x units of DHS for 30 days. Stereotypies were seen in 35 x horses out of N=120. The prevalence was 29.16% (4x horses displayed Kicking 3.3%, 10x horses displayed biting 8.3%, 9 x horses displayed weaving 7.5% and 7x horses displayed crib-biting 5.83%). The prevalence in group A= 27.5% (11 x horses displayed out of N=40), group B= 27.5% (11 x horses out of N=40) and group C 32.5 % (13 x horse out of N=40) were observed as data shown in **Error! Reference source not found.**

**Phase-IV:** N=120 horses were kept group wise in the 3 x units GHS for 30x days. The stereotypies were seen in 22 x horses out of N=120. The prevalence was 18.3% (5x horses displayed Kicking 4.16%, 5x horses displayed biting 4.16%, 5x horses displayed weaving 4.16% and 7x horses displayed crib-biting 5.83%) were observed. The prevalence in group A= 17.5% (7 x horses displayed out of N=40), group B= 17.5% (7 x horses displayed out of N=40) and in group C= 18.3% (8 x horses displayed out of N=40) were recorded data shown in **Error! Reference source not found.**

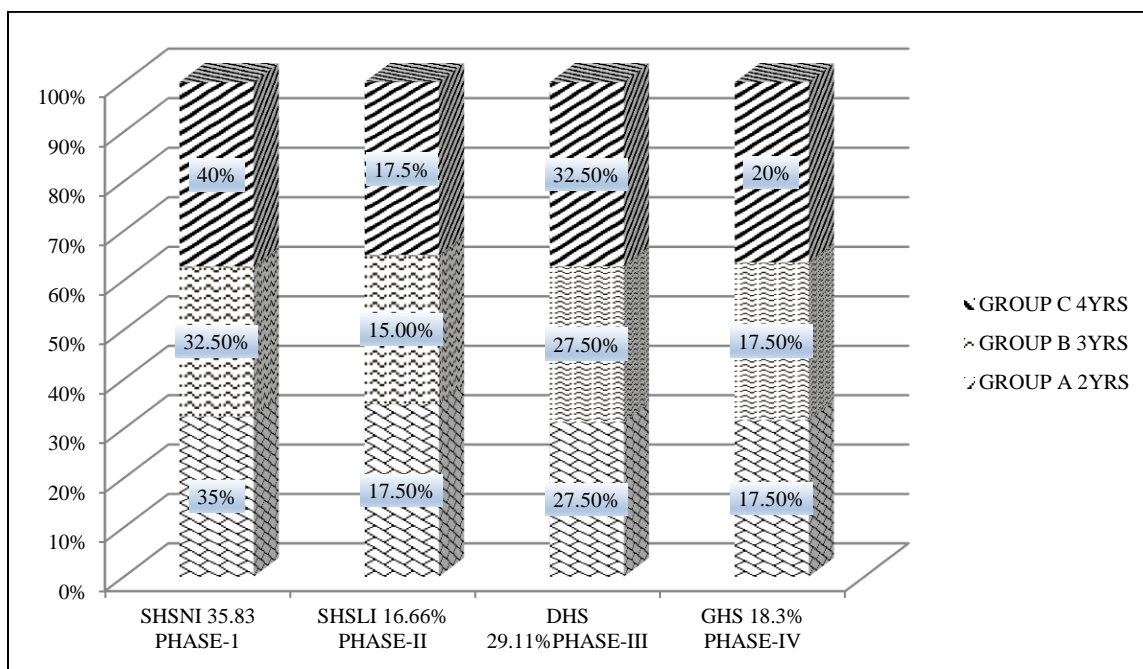


Figure- 5. Phase based abnormal behaviour in different housing systems

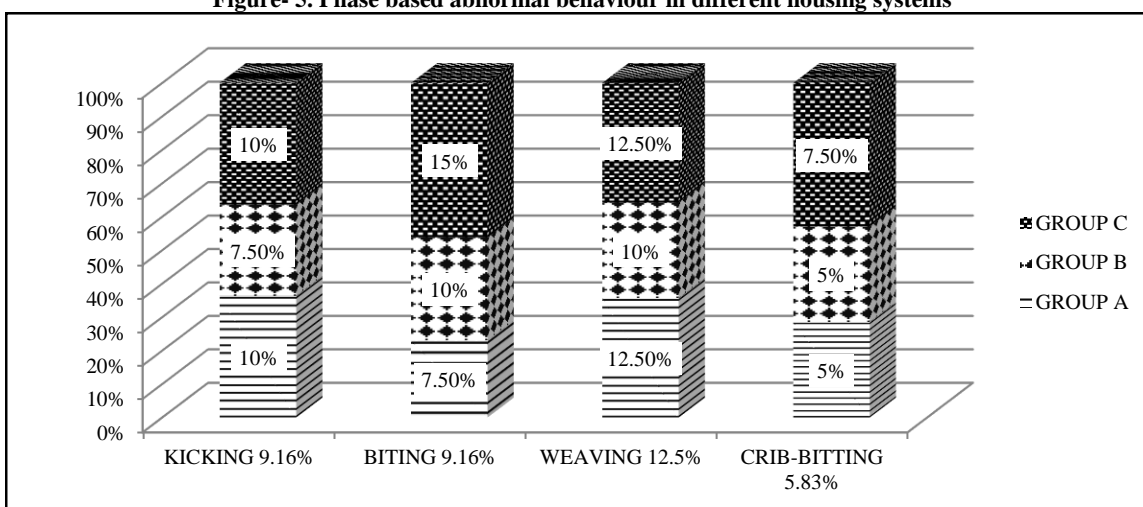


Figure-6. Group wise prevalence of abnormal behavior in different housing systems

Table-1 Experimental Design

Phase	Horses	Housing System	Duration	Reading			Remarks
				1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	
I	N=120 TBP	120 x units of SHSNI were used (in every unit horse was kept as single)	30 x days	10 <sup>th</sup> day	20 <sup>th</sup> day	30 <sup>th</sup> day	3 readings of every horse were recorded for 30 days
II	“	120 x units of SHSLI were used (in every unit horse was kept as single)	“	“	“	“	“
III	“	60 x units of DHS, (horses were kept in pairs instead of single in each unit)	“	“	“	“	“
IV	“	3 x units of GHS (40 x horses were kept in one unit of each group (Group A, B, C))	“	“	“	“	“
<b>Total</b>	<b>N=120 Horses</b>	<b>303 Housing Units were used</b>	<b>Duration was 120 x days</b>	<b>12 x readings of every horse were recorded</b>			<b>12x120=1440 total readings were recorded</b>

**Table- 2 Comparison of abnormal behavior among groups in different housing systems**

Group	SHSNI	SHSLI	DHS	GHS
	Phase-I	Phase-II	Phase-III	Phase-IV
A (n=40)	35% (14 x horses)	17.5% (7 x horses)	27.5% (11 x horses)	17.5% (7 x horses)
B (n=40)	32.5% (13 x horses)	15% (6 x horses)	27.5% (11 x horses)	17.5% (7 x horses)
C (n=40)	40% (16 x horses)	17.5% (7 x horses)	32.5% (13 x horses)	20% (8 x horses)
<b>Overall (n=120)</b>	<b>35.83%</b> <b>(43 x horses)</b>	<b>16.66%</b> <b>(20 x horses)</b>	<b>29.11%</b> <b>(35 x horses)</b>	<b>18.33%</b> <b>(22 x horses)</b>

**Table- 3 Comparison of various stereotypies**

Stereotypies	Phase-I	Phase-II	Phase-III	Phase-IV	Total
	SHSNI	SHSLI	DHS	GHS	
Kicking	9.16%	3.3%	7.5%	4.16%	6.45%
Biting	9.16%	2.5%	8.3%	4.16%	6.03%
Weaving	11.66%	5%	7.5%	4.16%	7.29%
Crib-biting	5.83%	5.83%	5.83%	5.83%	5.83%
<b>Total</b>	<b>35.81%</b>	<b>16.63%</b>	<b>29.13%</b>	<b>18.31%</b>	<b>24.92%</b>

## DISCUSSION

The study's finding of the highest prevalence of stereotypies (35.83%) in the Single Housing System No Interaction (SHSNI) during Phase-I aligns with similar research conducted by Waters *et al.* (2002), who also reported a 35% prevalence of stereotypies in stable horses. The key contributing factor in both studies appears to be the design of the housing system, which isolates individually kept horses from visual and tactile social interaction. This isolation is achieved through the use of high walls without windows or grilles, effectively depriving horses of social contact. The conditions created by such isolation, confinement, and deprivation of social interaction can lead to feelings of frustration, boredom, stress, and psychological anxiety in horses, as noted by Yarnell *et al.* (2015). These factors are generally considered predisposing and underlying causes for the development of classical stereotypies. Borroni and Canali (1993) also reported a high frequency of stereotypies in isolated stabled Thoroughbred horses. Multiple epidemiological and experimental studies have consistently pointed to frustration, boredom, and stress as key underlying causes of equine stereotypies, as highlighted by Wickens and Heleski (2010). The lack or deprivation of social contact is typically listed as a predisposing or contributing factor to the development of abnormal behaviors in horses, as discussed by McBride and Hemmings (2009). These findings underscore the importance of social interaction and environmental enrichment in promoting the psychological well-being of stabled horses.

The second-highest occurrence of unwelcome behavior, at 29.11%, was observed in the Double Housing System (DHS) during Phase-III. This finding aligns with a study conducted by Waters *et al.* (2002), suggesting that the results of this study are consistent with previous research. In the DHS, horses were paired

together instead of being individually housed, as was the case in both the Single Housing System No Interaction (SHSNI) and Single Housing System Limited Interaction (SHSLI) housing systems. The pairs of horses were selected randomly within their respective groups, allowing for intense social interactions, both visually and tactilely. When comparing the data from the DHS housing system to the SHSLI housing system, it was observed that 14 additional horses developed stereotypies, resulting in an increased prevalence of 11.6%. Kicking, biting, and weaving stereotypies were observed during the study, but there was no change in the prevalence of crib-biting. The primary contributing factor for the increase in stereotypies may have been that the horses had not previously been in close contact with each other, and thus, they had not developed sharing behaviors, especially in terms of sharing personal space, food, freedom, and establishing hierarchy. Christensen *et al.* (2002) also reported similar results, noting that group-housed horses were more prone to aggression when first placed in close contact, as they lacked the sharing behavior typically developed through social interaction. Horses often learn and develop social behaviors from their peers. Unfamiliarity among horses can elevate stress levels, but when horses are familiar with each other, it tends to reduce stress and abnormal behaviors. It's worth noting that the results of this study contradict those reported by Ruet *et al.* (2019), who found that individual boxing is an effective housing system with fewer developed stereotypies and a significant positive impact on enhancing welfare. These contradictory findings may be influenced by various factors, including differences in management practices, the size and shape of individual boxes, and other environmental variables.

The lowest prevalence of undesirable behavior, at 16.66%, was observed in the Single Housing System with Limited Interaction (SHSLI) during Phase II. This result aligns with findings from previous studies. For

instance, McGreevy *et al.* (1995) reported a 15% prevalence of stereotypies in stabled horses, and Mills *et al.* (2002) found a similar result of 16.4% stereotypies in 2-year-old stabled Thoroughbred horses. When comparing the results of Phase II (SHSLI) to Phase I (SHSNI), where the prevalence of stereotypies was 35.83%, it becomes apparent that the most significant contributing factor to the reduction in the frequency and intensity of stereotypies was the design of the housing system. Specifically, the presence of windows or gridded walls that allowed for visual and vocal social interaction played a crucial role. This design feature enabled horses to engage in social interactions even when they were individually housed. These findings are consistent with the study by Ruet *et al.* (2019), which reported that individual boxes allowing for visual interaction among horses were associated with reduced behavioral changes. Additionally, McGreevy (1995) found that the design of individual boxes that allowed visual contact between horses was linked to lower levels of stereotypic behavior in stabled horses. In essence, when horses transitioned from being kept in complete isolation (as in SHSNI) to having the opportunity for visual and vocal social interaction (as in SHSLI), they exhibited a decrease in previously developed abnormal behaviors, likely due to the introduction of social interaction and environmental richness.

The second-lowest prevalence of stereotypies, at 18.33%, was observed in the Group Housing System (GHS) during Phase IV of the study. This result is in line with the findings of Cooper *et al.* (2000), who reported that allowing close visual and tactile contact with neighboring horses significantly reduces stereotypic behaviors in stabled horses. Horses are inherently group-living animals, and their natural evolution has shaped them to thrive in group environments, as noted by Linklater (2000) and Waring (2003). The reduction in the prevalence of stereotypies observed in the GHS is likely influenced by the development of sharing behavior among the horses. When horses were previously kept in pairs in the Double Housing System (DHS), they had the opportunity to learn and develop sharing behavior from their companions. This sharing behavior extended to sharing personal spaces and freedom. Initially, they may have exhibited non-social behaviors, but during Phase III (DHS), as they experienced social practices and close contact, they developed sharing behavior. It's worth noting that horses require sharing experiences to develop appropriate social skills, as highlighted by Bourjade *et al.* (2009). This shift from isolation or limited interaction to group housing with close social contact appears to have had a positive impact on reducing stereotypic behaviors among the horses, emphasizing the importance of fulfilling their social and behavioral needs in captivity.

The result showed the conspicuous variation in cases of kicking, biting, and weaving but no variation recorded in crib-biting. The cases were high in SHSNI and immediately dropped in SHSLI and again high frequency was recorded in DHS and then low frequency

was observed in GHS. The abrupt change in housing system is visual relaxation in SHSLI while in DHS the horses could not develop a positive interaction and developed stereotypies.

## Conclusion

This study highlights that the Single Housing System with Limited Interaction (SHSLI) appeared to be a more suitable housing system compared to others, contributing to the better welfare of horses. It encourages maximum social interaction, reduces stress and stereotypic behaviors, and minimizes the risk of injuries compared to alternative housing systems. This underscores the importance of considering the social and psychological well-being of horses alongside their physical needs in modern equine husbandry.

## AUTHORS CONTRIBUTION

MN, AAB and NR conceived and designed the study. ASAB executed the experiment, ASAB MN, and SAT analyzed the data. ASAB, MN, NNM and SAT designed and corrected the manuscript. All authors approved of the final version.

## CONFLICT OF INTEREST

Authors declare no conflict of interest.

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