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Consensus recommendations on communication, language and speech in Phelan-McDermid syndrome

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ABSTRACT

Phelan-McDermid syndrome is a genetic condition primarily caused by a deletion on the 22q13.3 region or a likely pathogenic/pathogenic variant of *SHANK3*. The main features comprise global developmental delay, marked impairment or absence of speech, and other clinical characteristics to a variable degree, such as hypotonia or psychiatric comorbidities. A set of clinical guidelines for health professionals covering relevant aspects of clinical management have been written by the European PMS Consortium, and consensus has been reached regarding final recommendations. In this work, attention is given to communication, language and speech impairments in PMS, and the findings from available literature are presented. Findings from the literature review reveal marked speech impairment in up to 88% of deletions and 70% of *SHANK3* variants. Absence of speech is frequent and affects 50%–80% of the individuals with PMS. Communicative skills in the expressive domain other than spoken language remain understudied, but some studies offer data on non-verbal language or the use of alternative/augmentative communication support. Loss of language and other developmental skills is reported in around 40% of individuals, with variable course. Deletion size and possibly other clinical variables (e.g., conductive hearing problems, neurological issues, intellectual disability, etc.) are related to communicative and linguistic abilities. Recommendations include regular medical check-ups of hearing and the assessment of other factors influencing communication, thorough evaluation of preverbal and verbal communicative skills, early intervention, and support via alternative/augmentative communication systems.

1. Introduction

Phelan-McDermid syndrome (PMS) is a rare genetic condition (prevalence estimate 1/30.000 births) primarily caused by a terminal deletion on the 22q13.3 region or a likely pathogenic/pathogenic variant of *SHANK3*. Recent consensus also incorporates interstitial deletions not including this gene (*SHANK3*-unrelated PMS) in this diagnosis (Phelan et al., 2022). The phenotype in PMS is characterized by global developmental delay/intellectual disability (ID), hypotonia and marked impairment or absence of speech, among other clinical characteristics with variable prevalence and severity, like autism spectrum disorder (ASD) (Phelan and McDermid, 2011; Schön et al., 2023, this issue).

Professionals and caregivers have been actively demanding over the

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Table 1
Typical development of communication, language and speech in interaction.

Child	Adult
0–6 months	
• Eye contact • Making sounds (vocalising) • Imitating facial expressions and mouth movements • Focused listening	• Slowing down, exaggerating, repeating own behaviour directed at the child • Monitoring the interactions • Talking about the child and his/her needs
6–9 months	
• Attention to objects • Mimicry and direction of gaze • Gestures (grasping, reaching, etc.) • Babbling • Turning behaviour	• Initiating communication about the child's interests • Many non-vocal forms to support spoken language
9 months–1 year	
• Conventional gestures (pointing, waving, clapping, etc.) • Conscious and specific communication of messages • Expansion of communicative functions	• Controlling dialogue
1–2 years	
• Initiating and guiding communication • Link between objects/actions and language (comprehension) • First 50 words	• Providing correct model and implicit feedback: repeating and extending child's expressions, asking for clarification
2–3 years	
• Multi-word expressions • First grammatical rules • Vocabulary up to 1000	• Providing correct model and implicit feedback: repeating and extending child's expressions, asking for clarification
3–5 years	
• Increase in complexity of utterances • Vocabulary up to 2000	• Providing correct model and implicit feedback: repeating and extending child's expressions, asking for clarification
5–10 years	
• Refinement of articulation skills • Acquiring exceptions to grammatical rules • Language use and conversion rules • Vocabulary expansion	• Providing correct model and implicit feedback: repeating and extending child's expressions, asking for clarification

Examples of child and adult interactive behaviour within the typical development of communication.

last years the need for a consensus guide and recommendations regarding Phelan-McDermid syndrome. This work was written by the European PMS consortium as part of a series of papers concerning Phelan-McDermid syndrome, which stem from the European Consensus Guidelines for PMS (Koza et al., 2023, this issue). This paper focuses on *SHANK3*-related Phelan-McDermid syndrome, defined by a deletion in the 22q13 terminal region or a pathogenic variant of *SHANK3*; however, the information presented may be applicable to *SHANK3*-unrelated PMS (Nevado et al., 2022; Phelan et al., 2022). In this paper, the focus is on communication, language, and speech. We present the main literature findings regarding these aspects in the population with PMS.

1.1. Development of communication, language, and speech

Communication, a fundamental feature of interpersonal contact, refers to the exchange of information between individuals, through verbal or non-verbal language. Language consists of agreements on the meaning of arbitrary symbols and their combination and speech is a form of verbally expressing language, relevant to many communication processes. However, non-verbal manifestations, like gestures, facial expressions, or gaze, also play a fundamental role. Communication facilitates the learning of skills in all other areas of development and is indispensable to participate and engage in the community. Typical development of communication, speech and language takes place primarily in the interaction between child and adult, and is also influenced by the language offerings and the interaction style of those who come in contact with the child on a regular basis (Hadders-Algra, 2021). During

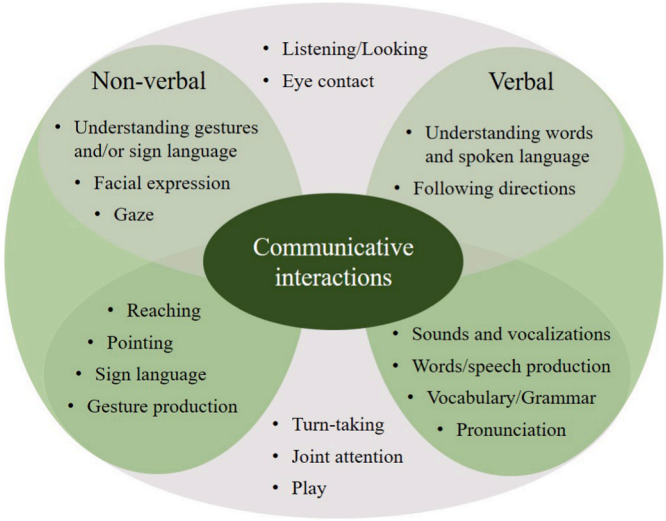

Fig. 1. Diagram showing examples of expressive and receptive communicative interactions within the verbal/non-verbal domains and their overlap.

the interactive moments, the child learns to master different communicative functions. A communicative function is an intention expressed by a person in interaction and can be used to regulate or concretise communication between individuals (e.g., paying attention to the partner, taking turns, greeting, etc.). Communicative functions are especially important in the period when language is not yet present (preverbal phase: 9–15 months), and in the first period of language acquisition (early verbal phase: 15–24 months) (van den Dungen & den Boon, 2001) (van den Dungen & den Boon, 2001). The development of communication, speech and language in interaction is schematically represented in Table 1, which also includes the main characteristics of adult behaviour.

Communicative development is the basis of speech and language development. In speech and language development, we have defined the following domains.

- Language comprehension (language perception, receptive language); requires the ability to perceive, recognise and process information.
- Language production (language expression, structure and meaning); requires the ability to recall information from memory and process it into words and sentences or gestures.
- Speech production (motor control and execution of speech sounds); through speech production processes, sounds and words are created.

In the case of PMS, in which language and speech are often severely impaired, other forms of communication acquire an even more important role. Fig. 1 represents some examples of the overlap in communicative interactions, both verbal/non-verbal and receptive/expressive. When an individual has difficulty expressing or understanding communicative signals or when others fail to respond to their signals, intervention is important to prevent developmental stagnation. It is indispensable to identify the strengths and difficulties in these interactions to enhance present skills and to promote communication.

1.2. Limitations in communication in PMS

Speech and language problems (e.g., delayed acquisition of language, problems with articulation or pronunciation, absent speech, or impaired ability to communicate either verbally or non-verbally, among others) occur in most individuals with PMS (Sarasua et al., 2014). Few studies to date delineate the communicative profile of PMS, but in a recent work Brignell et al. (2020) expose the receptive and expressive

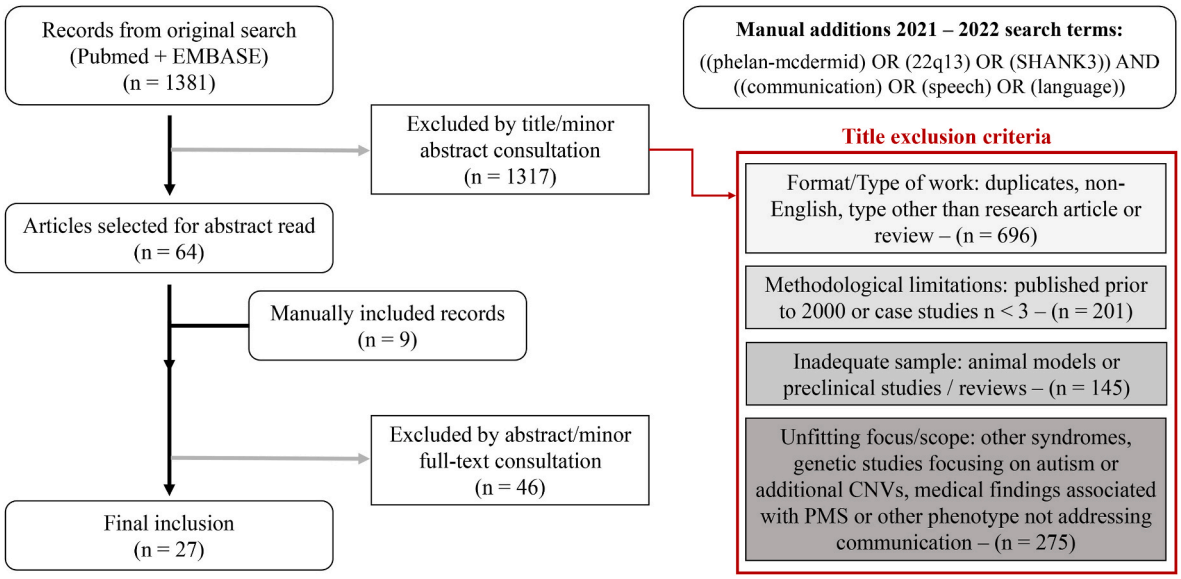

Fig. 2. Flowchart describing the selection process, title exclusion criteria and manual search terms.

skills of 21 individuals with PMS, including non-verbal communicative acts. The limitations in communication are one of the most common concerns of parents. The parent survey conducted in preparation for this guideline found that all parents experience speech and language difficulties in relation to their children with PMS (Landlust et al., 2023, this issue). Moreover, individuals with speech and language problems are also at increased risk of social, emotional, and behavioural problems (Lindsay et al., 2007). This highlights the importance of the promotion and facilitation of communication in individuals with PMS.

A language development disorder only exists when there are difficulties in the acquisition and use of language in any form and if the level of language ability is substantially and quantifiably below the age expectation, not better explained by other sensory, neurologic or intellectual impairment (American Psychiatric Association, 2022). The development in PMS is, in general, globally delayed, and there may be challenges in other areas apart from language development. In any case, few studies have looked specifically at the different aspects of communication, language and speech impairments in PMS.

2. Methods

The European PMS consortium is composed of several European health professionals, researchers and patient representatives; more information can be found in the editorial of this special issue.

For this publication, the designated working group within the consortium, composed of two clinical psychologists (MBO, AS), a speech pathologist (SvW), a geneticist (JN) and a patient representative (SP), performed a literature search on communication, language and speech in PMS. All these professionals have clinical experience and/or research expertise on neurodevelopmental conditions and specific genetic syndromes, including PMS.

Within the European guidelines' framework, MBO repeated the original search performed for the Dutch PMS guidelines in 2021. The search terms were, for PubMed: ((“telomeric 22q13 monosomy syndrome”[Supplementary Concept]) OR “shank3 protein, human”[Supplementary Concept] OR “chromosome 22 ring”[Supplementary Concept] OR (“ring 22[tiab]) OR “Phelan-McDermid[tiab] OR (((22q [tiab] AND terminal [tiab]) OR 22q13[tiab] OR SHANK3[tiab]) AND (deletion[tiab] OR monosomo[tiab] OR syndrome[tiab]))), and for EMBASE: ((‘phelan-mcdermid syndrome’/exp OR ‘ring chromosome 22’:ab,ti OR ‘phelan mcdermid’:ab,ti OR (‘22q terminal’; ab,ti OR 22q13:ab,ti OR shank3:ab,ti) AND (deletion:ab,ti OR monosomy:ab,ti OR syndrome:ab,ti))) AND [embase]/lim.

This search yielded a total of 1381 papers. MBO, JN, SvW and AS agreed on exclusion/inclusion criteria. MBO conducted the first part of the selection process and excluded 1317 papers after title and, in doubtful cases, minor abstract read, leaving 64 potentially relevant works. This process was repeated with an intra-rater reliability of 99%. For the writing of this paper, MBO manually sought in PubMed the period encompassing 2021–2022 for relevant studies surpassing exclusion criteria and found 9 additional studies. Abstract read of the 73 relevant works was divided among MBO, JN, SvW and AS, and led to further exclusion of 46 due to 1) Inadequate sample (*SHANK3*-unrelated PMS); 2) Unfitting focus (topic other than communication, language or speech, redundant reviews or characterisations, topics addressed by other European PMS guideline chapter or general descriptions of *SHANK3* alterations not specific to communication) and 3) Limitations in methodology (n < 15 subjects unless communication or language-focused). Finally, 27 studies were included. Selection flowchart, search terms for the manually added papers and title exclusion criteria can be found in Fig. 2.

The literature was selected and sorted following a set of fundamental questions formulated based on the pre-existing Dutch PMS guidelines. Additionally, parents and caregivers were surveyed online about relevant topics and main concerns, and these responses were also used to substantiate the fundamental questions (Landlust et al., 2023, this issue), as.

- What is the prevalence of communication, language, and speech problems in PMS, and are there specific types of problems?
- What is the mechanism behind the communication, language, and speech problems in PMS?
- What is the guidance for communication, language, and speech problems with PMS?

During the elaboration of the guidelines, we followed the AGREE II (Appraisal of Guidelines for Research and Evaluation-II) methodology (Brouwers et al., 2010). The working group held monthly online meetings to review and discuss the available literature, and to compile the main findings in a chapter of the guidelines. A patient representative (SP) was involved in the working group discussions. The written chapter was then shared among and commented by the rest of the consortium members, which also included patient representatives. After two revisions from the larger consortium group, a final text was produced,

Fig. 3. Verbal language capacity and age of acquisition. A) Error bars represent standard error. B) Data points represent youngest and oldest ages at which words and sentences were acquired. Not all the available papers provided sufficient information on verbal language abilities to be considered, and some were omitted due to possible sample overlap. Considered papers are: A) Brignell et al., 2020, De Rubeis et al. (2018); Droogmans et al., 2019; Meersman et al., 2020; Nevado et al. (2022); Samogy-Costa et al. (2019); Sarasua et al. (2014), Soorya et al. (2013); Tabet et al. (2017); B) De Rubeis et al. (2018); Burdeus-Olavarrieta et al. (2021); Tabet et al. (2017).

conclusions were agreed upon and consensus was reached on the recommendations via voting during an in-person meeting in Groningen (20^{th}-22^{nd} June 2022), after which this publication was formatted and finalized.

3. Review of the literature

3.1. Prevalence of communication, language and speech problems in PMS

One of the most common features of individuals with PMS is delayed or absent speech (Droogmans et al., 2019; Phelan and McDermid, 2011; Zwanenburg et al., 2016). Overall, recent literature shows a high proportion of individuals who are non-verbal, but also a high heterogeneity in verbal and non-verbal interactive behaviours (e.g., gestures, sentences, words or sounds). In an exhaustive study, Brignell et al. (2020) analysed the receptive and expressive communicative abilities of 21 participants and found a mean age equivalent of 14 months, and highest age equivalents of around 6 and 4 years respectively. Speech was absent in around half of the sample, but over 80% showed basic communicative acts, such as choosing, requesting an object, rejecting or drawing attention to self. In a study examining factors affecting parental satisfaction with speech therapy in children with PMS ($n = 39$) only 17.4% of the participating children were verbal, with 10.9% using a blend of non-verbal and verbal language; 71.8% were non-verbal but interactive with their environment with or without alternative/augmentative devices and 7.7% were non-verbal and not interactive in social overtures (Meersman and Mathieson, 2020). Samogy-Costa et al. (2019) categorized 25 patients within the following categories: speech absence, unintelligible speech (babbling), speaks a few words and speaks sentences; 84% showed unintelligible or absent speech and only 12% were able to speak in sentences. In another study on communication in PMS (n = 15), 53.3% of the participants were reported to be verbal, but these authors differentiated within verbal communication by categories as 'use of particular sounds' (13.3%), 'use of single words' (6.7%), 'use of words' (6.7%) and 'use of short sentences' (26.7%) (Vogels et al., 2021). Recently, Nevado et al. (2022) in a cohort of 199 patients reported that 35% showed absent speech, around 39% used some words and 25% were able to speak in sentences. In another study with 54 participants over 3 years, 35% of them could use at least short sentences to communicate (Burdeus-Olavarrieta et al., 2021). Overall, there is a marked speech impairment in PMS, affecting both patients with deletions and with *SHANK3* variants (see also Schön et al. (2023, this issue)).

Some infants with PMS may babble at a typical age, although concerns around speech, communication and social interaction are in many cases one of the initial reasons for clinical consultation. Developmental milestones acquisition, specifically regarding speech production, is typically delayed, with wide age ranges, e.g., in a small study by Philippe et al. (2008), age at first words ranged from 2 to 6 years for verbal participants, and sentences appeared after 5 years. Burdeus-Olavarrieta et al. (2021) reported even broader ranges, with first words being acquired from 8 months to 6 years and sentences from 2 to 14 years. In another study with patients with *SHANK3* variants, age at first words ranged from 8 months to 4 years for those who acquired language (De Rubeis et al., 2018). Information on verbal capacity and youngest and oldest age of verbal language acquisition (from papers with available data) are summarized in Fig. 3.

In some cases, individuals may perform relatively better at receptive language in contrast to expressive language (Phelan and McDermid, 2011). However, these findings usually show wide ranges of performance and possible methodological limitations concerning testing floor effects, thus either failing to meet statistical significance or unfit for statistical comparison (Brignell et al., 2020; Soorya et al., 2013; Zwanenburg et al., 2016). On another study with 18 participants with PMS, Droogmans et al. (2019) differentiated between receptive non-verbal and receptive verbal communication and found individuals to score remarkably lower on receptive non-verbal communication compared to the verbal counterpart.

In some cases, there is a loss of skills that sometimes affects speech or sound production during early childhood. In a study with 42 participants, 18 presented with loss of skills, of which 6 concerned language or social engagement, with an average onset between 3 and 5 years of age (Reierson et al., 2017). In around 40% of the individuals, lost skills were slowly recovered after a variable period of time. Soorya et al. (2013) reported a history of loss of skills in 28% of the participants, most commonly affecting language, with an onset ranging from 15 months to 17 years. Another study with 60 participants showed 25 parental reports of loss of skills, 23 involving language and speech/vocalizations production and 21 (mostly overlapping) entailing loss of social engagement and reciprocity (Burdeus-Olavarrieta et al., 2021). When inquiring about possible underlying causes, 4 families reported loss of skills occurring around concrete medical events, although this information must be interpreted with caution (among others, due to its retrospective nature and the possibility of recall bias). Of the 25 individuals, 10 regained a similar level of functioning after a time ranging from several months to several years. While it is hard to characterize developmental regression as typically defined (prolonged loss of consistently acquired skills) in PMS, especially regarding language, it is important to be aware

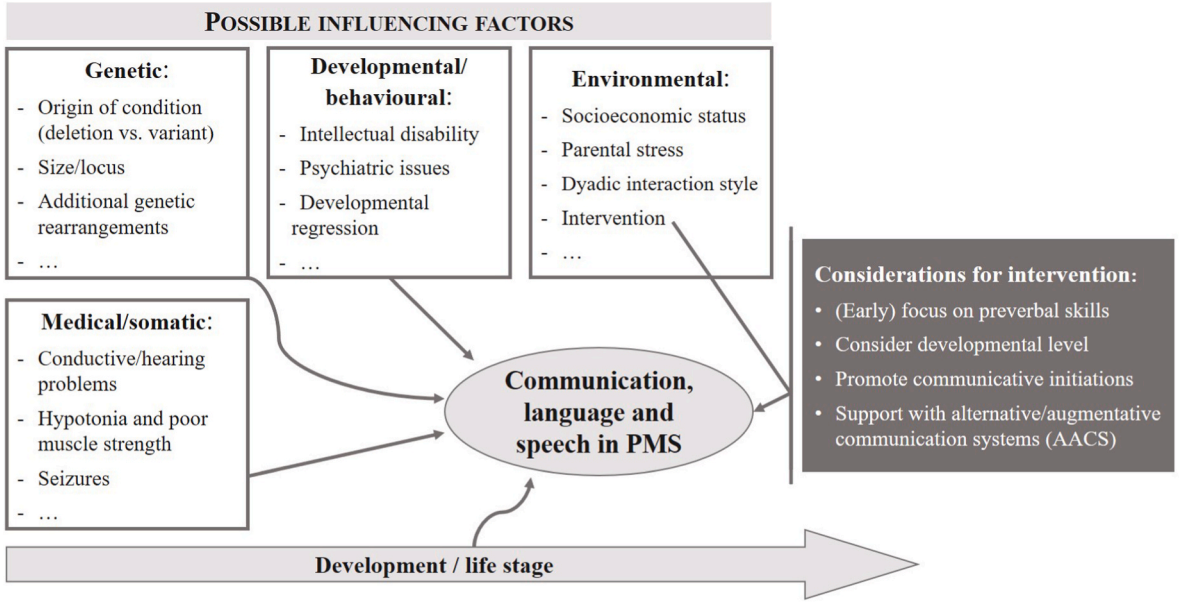

Fig. 4. Diagram showing factors possibly associated with communication/language in PMS and key considerations to address in interventions.

of the possibility of loss of communicative and preverbal skills, including babbling, joint attention, pointing or other forms of communicative approaches and responses. In some cases, therapy and communication training, ideally including parent training, may promote communicative abilities and help increase or regain vocabulary or social overtures. Nevertheless, mild-to-severe impairment of expressive speech will likely remain throughout their lives (Phelan and McDermid, 2011).

Altogether, research focusing specifically on communicative and language abilities of individuals with PMS is scarce. The authors recommend future longitudinal studies to further explore this field, preferably from the domain of preverbal and speech therapy, as these clinicians and researchers have expertise in capturing precursors of communication and language and early cognitive signals (as is suggested by Soorya et al. (2018) as a more valid alternative to standardized tests). Research covering developmental regression or specific loss of skills, including possible causes, developmental courses of these episodes and associations with other clinical factors is also warranted.

3.2. Associated features with communication, language, and speech problems in PMS

To the best of our knowledge, very few studies have looked specifically at the mechanisms underlying the communication, language, and speech problems in PMS. Particularly, Ponson et al. (2018) conducted auditory evoked potentials in 10 participants and found an atypical N250 latency suggestive of abnormal auditory cortex maturation, although the small sample size did not allow for statistical analyses. Another comparative study investigated the perception of auditory communicative signals in children with PMS and idiopathic ASD and found greater, although limited, superior temporal gyrus (involved in speech processing) activation towards communicative vs. non-communicative auditory stimuli in the PMS group, as well as an association between language skills and selective activation of the medial prefrontal cortex (involved in social cognition and language) (Wang et al., 2016). Despite the paucity of specific studies investigating the underlying mechanisms of communication, there are associated features often contributing to the communication, language, and speech problems in PMS. These features, summarized in Fig. 4, include.

- Genetic and medical issues, such as:
  - o Size of the deletion: The role of deletion size has been disputed, with some authors finding consistent associations between the size of the deletion and verbal abilities, so that smaller deletions are associated with more preserved language (Brignell et al., 2020; Nevado et al., 2022; Samogy-Costa et al., 2019; Sarasua et al., 2014), better communicative abilities within adaptive skills (Oberman et al., 2015) and less impairment in ASD social communication symptoms (Soorya et al., 2013), while others don't find clear associations (Droogmans et al., 2019). Tabet et al. (2017) mapped different phenotypes in relation to the size of the deletion and showed an absence of speech for 80–100% of the patients carrying 5–6 Mb terminal deletion of 22q13 (precisely with a breakpoint at location 46–47 Mb on chromosome 22q13), a similar finding to that described by Nevado et al. (2022).
  - o Carriers of *SHANK3* variants: Around 69–71% of patients with *SHANK3* variants also showed marked speech impairment (De Rubeis et al., 2018; Nevado et al., 2022; Xu et al., 2020), but most of the individuals who were able to make sentences clustered in the pathogenic *SHANK3* gene variants or the small deletions groups (<0.5 Mb) (Nevado et al., 2022). In fact, there is certain evidence that some *SHANK3* polymorphisms may mediate speech phenotypes in non-clinical population (Manning et al., 2021).
  - o Neurological problems such as hypotonia that cause trouble with oral motor skills and motor programming and control. Although a specific association between oral motor difficulties and problems with speech has not been studied in PMS, some studies have covered this topic, e.g., Brignell et al. (2020) found deficits in oral motor function, such as difficulties with tongue and lip movements (4/7 participants), open mouth posture and/or poor saliva control (14/21 participants), as well as structural anomalies like a high palate (2/7 participants). In fact, a high palate was found in almost half (49/104) of the participants assessed by Sarasua et al. (2014), which can lead to problems with tongue positioning and abnormal mouth habits.
  - o Conductive hearing problems or impairment as a result of frequent middle ear infections (Soorya et al., 2013; Wilson et al., 2003).
- Developmental-behavioural issues (see also van Balkom et al. (2023, this issue) such as:
  - o Moderate to severe intellectual disability (Droogmans et al., 2019; Phelan and McDermid, 2011), and delays in cognitive skills, such

Table 2
Conclusions from the literature review on communication, language, and speech in PMS.

Communication, language, and speech problems occur in almost all individuals with PMS, with varying degrees and domains of impairments.
Speech production is particularly impaired, with rates of individuals able to speak at least in short sentences ranging from 12% to 35%.
Receptive communication abilities observed by parents seem more preserved than expressive abilities, although these differences are descriptive and real performance usually overlaps when analysing aggregated data.
Deletion size plays an important role in communication, language, and speech: in general, smaller deletions or *SHANK3* variants are associated with more preserved language abilities, although individual variability is wide.
Several factors other than deletion size can influence communication/language/speech difficulties, such as other genetic variants, cognitive development or behavioural, neurological, or medical challenges.
Communication consists of multiple abilities; preverbal skills need to be considered, thoroughly assessed and addressed in interventions.

as processing information, using memory and applying stored information (Vogels et al., 2021; Zwanenburg et al., 2016).

- o Delays or difficulties regarding adaptive behaviour and social-emotional development and comorbid psychiatric diagnoses, such as autism spectrum disorder or mood disorders that make language difficult to understand or otherwise impair communicative function (Kolevzon et al., 2019; Oberman et al., 2015; Phelan and McDermid, 2011; Soorya et al., 2013; Vogels et al., 2021; Zwanenburg et al., 2016).
- o Possible episodes of developmental regression or temporary loss of skills concerning language and communication. Additionally, developmental regression of self-help, motor or language abilities might also co-occur with psychiatric symptoms, such as mood episodes or bipolar disorder (Denayer et al., 2012; Kohlenberg et al., 2020). In fact, in their recent review, Kolevzon et al. (2019) inform of loss of skills affecting language in 62% of the participants with such psychiatric symptoms.

Following the review of the available literature several conclusions are drawn and compiled in Table 2.

4. Discussion

A literature review on communication, language and speech in Phelan-McDermid syndrome has been presented, including prevalence of speech and language impairments, importance of non-verbal communicative skills and a brief overview on possible associated factors influencing communication.

From the moment of diagnosis, practitioners should keep in mind that there is a potential risk for communication, language, and speech problems in individuals with PMS, especially for those with terminal 22q13 5–6 Mb deletions or over this size (Nevado et al., 2022; Tabet et al., 2017). As stated, various factors can influence this, including frequent ear infections, developmental delay, behavioural problems, and neurological problems. The relative contributions of these factors in individuals with PMS is difficult to determine and can also differ per individual. This may explain the varying severity of communication, language, and speech problems in this group.

Given the high frequency and severity of communication problems in individuals with PMS, it is important to understand the underlying cause of the problem, and to work from the specific question: "What does the individual with PMS need to be able to (better) communicate?", for both the assessment and the subsequent intervention. Preferably, this should be done by a speech therapist specialized in preverbal communication, with expertise in severe communication problems in persons with multiple disabilities and augmentative/alternative communication systems (AACS), to promote speech abilities when possible or other means of communication when needed.

Individuals with PMS who speak little or not at all should be systematically examined for sensory-motor skills that can be functionally used or trained for communication. Evaluation of oral motor and sensory motor skills is necessary to adjust expectations regarding speech development and for selecting appropriate supportive communication aids. Additionally, the evaluation of specific conditions for communication focuses on the communicative behaviour of the individual with PMS and the interaction style of the communication partner in spontaneous interactions, as well as the understanding and production of language (receptive and expressive language). An overview of available measuring instruments can be found in Supplementary Table 1. It should be borne in mind that not all language tests are suitable and validated for individuals with PMS, but they can give an impression of possibilities and limitations in speech/language development. For other details on oral motor and sensory domains, see also Matulevičienė et al. (2023, this issue) and Walinga et al. (2023, this issue).

4.1. Intervention and/or guidance for communication, language, and speech problems in PMS

There are no specific publications encompassing the topic of treatment and intervention in communication/language in PMS, other than the work of Meersman and Mathieson (2020) that covers parental satisfaction with speech therapy. Given the fact that communication, language, and speech are variably delayed or impaired in this population, it is of utmost importance to identify individual needs and challenges with the guidance of a specialized professional. A thorough assessment of the level of communicative intentions and functions is warranted, as is the identification of the conditions for communication, receptive and expressive language, and oral motor skills/articulation. A recent review offers guidance on how to tackle the challenges that the assessment of populations with severe intellectual disability pose to many standardized instruments (Soorya et al., 2018), and one previous study exposes the potential utility of a speech analysis software for capturing vocalizations in a sample of minimally verbal participants with PMS (Rankine et al., 2017).

Although not PMS-specific, one of the central interventions for communication and language problems in non-verbal population with ID is preverbal therapy, which can focus on oral motor skills or on offering supported communication in the form of gestures, photos, pictograms, or a dynamic tool such as communication device with speech output (Marrus and Hall, 2017). A common concern among parents is that the use of alternative or augmentative communication devices may impede the development of spoken language; however, there is increasing evidence that supportive communication can be deployed at a very early stage without hindering the development of spoken language (Kasari et al., 2014; Romski and Sevcik, 2005). At a later stage, if the communicative development of the child permits, attention can shift to receptive and/or expressive language. However, the child's cognitive development and socio-emotional level must be considered. For non-speaking children, we recommend turning to the International Society for Augmentative and Alternative Communication (ISAAC) for help with stimulation of non-verbal communication.

Proper advice and intervention/support for communication, language, and speech difficulties in individuals with PMS should consider the various factors that affect these abilities, as already shown in Fig. 3. It is recommended that practitioners start treatment/counselling as early as possible, preferably as soon as the diagnosis is made. It is essential to refer patients to a hearing specialist or/and a multidisciplinary team where all these factors can be analysed. Conditions for communication are essential. Care must be taken to pursue speech therapy at the appropriate developmental phase of the individual, as failing to do this can lead to frustration in the child, parents, and practitioner. Communication difficulties may lead to behavioural problems/challenging behaviours (e.g., self-injury) (McClintock et al., 2003). An expert preverbal therapist is of great importance, as is the support from a

Table 3
Recommendations as agreed upon by the European Phelan-McDermid syndrome consortium.

Hearing should be checked in every individual with PMS at the time of diagnosis and subsequently put into surveillance according to national guidelines.
Every individual with PMS should be assessed by a specialized multidisciplinary team to evaluate all factors that may influence communication, speech and language.
Preverbal and verbal communicative skills and cognitive development should be thoroughly evaluated in individuals with PMS prior to intervention and treatment.
Parents of individuals with PMS should be counselled by a specialist on supporting, facilitating, and stimulating communication, language and speech from an early age on.
Use of augmentative and alternative communication (AAC) tools is recommended to facilitate communication for individuals with PMS when communication is limited; these approaches do not delay the active language development.

(paediatric) psychiatrist when needed.

4.2. Recommendations

All these considerations from the literature, along with expert opinion from the working group members and the feedback from the extended consortium, permit the establishment of a set of recommendations for clinical and daily care of individuals with PMS regarding their communicative skills and challenges. Table 3 contains these consensus recommendations provided by the European PMS Consortium.

After reviewing the available literature comprising the topic of communication in PMS, we encourage that more research into the particularities of communication, language and speech in PMS be conducted, encompassing fundamental aspects such as analysing relative deficits and strengths in communicative interactions, establishing the effectivity of interventions or delving into the underlying mechanisms of communication and language production and comprehension.

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CRediT authorship contribution statement

Monica Burdeus-Olavarrieta: Conceptualization, Methodology, Validation, Writing – original draft, Writing – review & editing. **Julián Nevado:** Conceptualization, Methodology, Writing – original draft, Writing – review & editing. **Sabrina van Weering-Scholten:** Conceptualization, Methodology, Writing – original draft, Writing – review & editing. **Susanne Parker:** Conceptualization, Writing – review & editing. **Ann Swillen:** Conceptualization, Methodology, Writing – review & editing.

Declaration of competing interest

The authors declare no conflict of interest.

Data availability

No data was used for the research described in the article.

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Appendix A. Supplementary data

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